A project report on

ASSESSING THE ENVIRONMENTAL AND SOCIAL IMPACTS OF QUARRY MINING PROJECTS IN MOGADISHU, SOMALIA

submitted in partial fulfilment of the requirements for the award of degree

of

Master of Technology

in

Environmental Engineering

Submitted by

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CANDIDATE'S DECLARATION

I, Jamal Faisal Ahmed, 2K21/ENE/01, M. Tech Environmental Engineering, hereby declare that the report entitled "**ASSESSING THE ENVIRONMENTAL AND SOCIAL IMPACTS OF QUARRY MINING PROJECTS IN MOGADISHU, SOMALIA**" submitted by me, for the partial fulfilment of the degree of Master of Technology to Department of Environmental Engineering, Delhi Technological University is a record of the M. Tech thesis project work carried out by me at Delhi Technological University. I further declare that this written submission represents my ideas in my own words and where other's ideas or words have been included, I have adequately cited and referenced the original sources. I affirm that I have adhered to all principles of academic honesty and integrity and have not misrepresented or falsified any idea/data/fact/source to the best of my knowledge. I understand that any violation of the above will cause for disciplinary action by the Institute and can also evoke penal action from the sources which have not been cited properly. This report has not been submitted for any other degree to any other university or institution to the best of my knowledge.

Place: Delhi

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CERTIFICATE

This is to certify that Mr. JAMAL FAISAL, M. Tech. student in the Department of Environmental Engineering has submitted a project report on "**ASSESSING THE ENVIRONMENTAL AND SOCIAL IMPACTS OF QUARRY MINING PROJECTS IN MOGADISHU, SOMALIA**" in partial fulfillment of the requirement for award of degree of Master of Technology in Environmental Engineering, during the academic year 2021-2023. It is a record of the student's research work undertaken under my supervision and guidance.

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ABSTRACT

This research focuses on the assessment of the impact of quarry mining activities on the environment and the nearby community in the Karan and Wadajir district of Mogadishu, Somalia. The study focuses on the effects of quarrying activities on society and the environment, as well as potential solutions to these problems. The research objectives include identifying the main factors contributing to improper quarrying activities, investigating the effects of such activities on the environment and its surrounding neighborhood.

The significance of this research lies in advancing knowledge about the effects of quarry extraction on natural and social settings. By studying the perceptions of nearby neighbors and corporate employees, the research aims to provide insights into how individuals in mining districts perceive the social and ecological consequences associated with quarry mining operations. The findings of this study can be used by planners, policymakers, and decision-makers to manage abandoned quarries effectively and turn them into secure locations. The research also aims to provide guidance on ecologically sustainable and friendly quarrying operations to fill the existing scientific and knowledge gap. The study is geographically limited to the Mogadishu quarries in the El-addo, Karan, and Wadajir districts. The research methodology involves a questionnaire surveys, interviews, and observations. The data collected from quarry workers, local residents, and environmental protection authorities are analyzed using descriptive statistics. The majority of respondents fell within the 26-35 age range, and quarry owners/operators constituted the largest occupation group. The level of awareness among quarry workers and operators about proper mining practices was rated as high by 34.5% of the respondents. While 34.5% of respondents were aware of negative environmental impacts caused by quarry mining activities, 65.5% reported being unaware. Factors contributing to improper quarrying activities include limited knowledge about sustainable mining practices, lack of regulations and enforcement, poverty and economic desperation, corruption and illegal activities, and insufficient government oversight.

The research findings contribute to raising awareness about the potential environmental effects of quarries and provide valuable information for mitigation and corrective actions. The results also inform decision-making processes and facilitate the proper management and rehabilitation of abandoned quarry sites. By filling the knowledge gap, the research supports the development of ecologically sustainable quarrying operations.

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Jamal Faisal Ahmed

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DEFINITION OF TERMS

Quarry Mining	open excavation from which stone or other material is extracted by blasting, cutting, or drilling
Quarry Stakeholders	those who involved quarry mining operations and its impacts.
Quarry Neighborhood	surrounding community which impacted by quarry mining
Drill Dust	dust of rock created by drilling
Blasting	detonation of explosives to break the rock.
Detonation	supersonic explosive reaction which creates high pressure shock wave, heat and gases.
Impacts	is a strong effect, or the powerful or dramatic effect that something has.
Vibration	instance of shaking or moving back and forth very rapidly. Or as the seismic waves travel through the rock, there are movements of the particles. This is commonly referred to as vibration
Air Blast	is often used to describe the air waves, which are generated by blasting activities.
Air Over Pressure	simply defines this as the pressure above the atmospheric pressure
Ground Vibration	caused by seismic waves travelling through the ground
Fly Rock	individual rock fragments being thrown long distances from the site by the force of the explosion (or undesirable throw of rock from the blast)
Misfire	charge or part of charge, which has failed to fire as planned.
Dust	very small dry particles such as sand either in the form of deposit or cloud.
Fumes	to emit gas, smoke, or vapor or be omitted in this form.
Noise	Audible air blast is called noise
Water contamination	act of water becoming contaminated, unclean or impure state.

LIST OF ABBREVIATIONS

CSR	Corporate Social Responsibility
dB	A-weighted measurement of sound level in Hz
EIA	Environmental Impact Assessment
KAAWO	Karan and Wadajir districts quarry project site
MMNR	Ministry of Mining and Natural Resources
NGO	Non-governmental organization
OSHA	Occupational, Safety, and Health Act
OUM	Open University of Malaysia
SIA	Social Impact Assessment
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNEP	United Nation Environment Program
USAID	United states Agency for international development
WCED	World Commission on Environment and Development
WHO	World Health Organization
WRM	World Rainforest Movement

CHAPTER 1

INTRODUCTION

1.1 Background

Excavation is not a recent occupation in the mining business, and this study explores the implications of mining intermediation and its core premise. The unprecedented period of global economic turmoil had an effect on the majority of businesses in the quarrying industry worldwide. Therefore, quarrying has a detrimental effect on the environment, which has a big impact on the economic development of most nations. Stone mining frequently results in land use conflicts in inhabited areas due to its negative external effects, such as the loss of vegetation, noise, dust, truck traffic, pollution, and aesthetically unpleasant landscapes. Additionally, it causes conflicts with other land uses, like as farming, particularly in areas where there is a lack of expensive farmland and where post-mining rehabilitation may be impossible(Goldsmith et. al 2012).

Environmental issues have gained prominence around the world in the last decade. The global community has established a number of international protocols to address emergent conservational matters. The Safety Management and Coordination Act (1999), the legislation governing the nation's environmental challenges, was passed in East Africa at the same time as these global reforms. The National Environmental Protection Act established the National Environmental Protection Mandate, which, among other things, monitors tools and examines development operations to ensure that ecological stability is not compromised.

For instance, quarrying in urban settings becomes significant in this regard. Because it stimulates trade, generates new jobs for people each year, and develops new habitats, quarrying is a significant supporter of regional economic progress. Occasionally, new roads are built to carry equipment and later remove materials, leaving them for locals to utilize. Apart from other economic activities, often these people in quarrying regions rely entirely on excavating for a livelihood(Jeffrey J. et al. 1986).

Most of Africa's countries do not manage quarrying well enough to maintain the ecosystem. Resource exploitation lacks organization and uses abhorrent techniques. Due to the fact that most quarries are kept open, there are no efforts made to repair them after they collapse. Consequently, it is now necessary than ever to conduct a detailed examination of how quarrying management affects the mining sectors. The effectiveness of institutions in managing quarrying improves because quarrying has an impact on the principles of ethical corporate governance, effective strategic management, and integrated management. The development of a region's transportation infrastructure is facilitated by quarrying, which is a significant human activity. In some way, the environment is impacted by man's quarrying activities. On both the physical and biological climates, these activities have an effect. According to Ross (2001), the individual quarry operators' inadequate mitigation methods exacerbate environmental issues. This has an impact on ecological

sustainability, which jeopardizes the general viability of the economy. There are zero efforts being made in monitoring, rehabilitation, restoration, or post-mining programs for reducing negative environmental impacts in relation to the current environmental legislation and its implementation.(Raghunathan et al. 2005)

According to Darwish et al. (2010), the majority of quarries in many developing nations are abandoned when quarrying operations are over. Because of the surface run-off and reduced natural recharge caused by abandoned quarries, the ecology is harmed. Despite this, improvements in resource efficiency are outweighed by continued increases in resource demand and extraction. However, a composite indicator of this kind does not provide details on specific resource developments. Increased demand, decreased supply, and supply instabilities brought on by the widespread extraction of natural resources from ecosystems and mines (1980 to 2005/2007SERI) have made the world's food, energy, and water systems appear more vulnerable and fragile than previously believed.

Environmental problems such as air pollution, water pollution, landfills, global warming, population growth, waste management, acidification of the oceans, extinction of species, ozone layer depletion, and deforestation are getting worse and worse, especially in densely populated cities. It has an effect on all facets of our ecosystem, including both people and animals. Urban air and water pollution have been linked to a range of health issues. As this study will analyze various quarry mining issues that the environment and the local population are dealing with before attempting to explain how these issues are resolved. The study will be focused on the effects and other mining concerns in quarries(Kumar , 2015).

A sizable amount of aggregates, estimated to be over 25 billion metric tons, are quarried every year throughout the industrialized and developing countries. The modern world depends on quarried aggregates, and these materials are utilized daily in buildings, roads, factories, schools, hospitals, retail establishments, offices, airports, and rail lines. Because of differences in rock types, geological settings and structures, and deposit topography, no two quarries are exactly alike in terms of construction. As a result, each quarry faces unique mining issues and has a varied effect on its surroundings. Quarrying practices have resulted in the growth of infrastructure, the invention of job opportunities, the expansion of towns, and the formation of various industries (Naveen Kumiar et al. 2012). Extraction and processing operations have also harmed the environment especially through land degradation. Land degradation is typically caused by mineral extraction for two reasons: Industrial growth comes first, followed by immediate economic gains like fulfilling production goals and job creation. The environment has been impacted by quarrying in both beneficial and harmful ways. Researchers from all over the world have frequently sought to determine how this activity has affected the surrounding environment.

Due to the abundance of limestone deposits in Somalia, the demand for stone has increased significantly, reaching 8.8 million tons. Numerous stone production projects are carried out by some construction firms, which are the top producers of stone in the nation. Basalt, sandstone and limestone quarries are owned by some people. Rock crushing and stone excavation are global phenomena that have alarmed industrialized countries all over the planet. Because it provides a significant amount of the materials used in old hard flooring, such as granite, marble, sandstone, slate, and even clay to manufacture ceramic tiles, quarrying is a crucial industry like many other man-made activities, quarrying has a considerable negative impact on the environment. It is usually required to use explosives to blast away stones in order to detach boulders from the phase for further processing, however this type of extraction degrades habitats and pollutes the air, noise, and biodiversity. The disappearance of biodiversity is one of quarrying's most serious effects on the environment. Fish, insects, mollusks, tortoises, birds, vertebrates, plants, fungi, and even bacteria are all included in the term "biodiversity," which refers to the variety of living creatures. All species are connected, even though this isn't immediately apparent or even known, and human survival depends on nature's delicate balance, making bio-diversity conservation crucial(Awoke Endalew et al. 2012)

Quarrying may result in the extinction of native species and the habitats they depend on. Even if the habitats are not physically destroyed by digging, environmental factors such as changes in groundwater levels or surface water levels, which cause certain habitats to flood while others dry up, can nevertheless have an indirect negative impact on and harm the habitats. Even pollution can have a significant impact on the ability of some species to reproduce. Notwithstanding, with careful management, the impact on biodiversity can be minimized, and quarries can also provide an excellent chance to construct new natural habitat or restore existing ones the El-addo limestone deposit, which is about 8 km southeast of the proposed location of the aggregate plant, is projected to supply the limestone that will serve as the primary raw material for the proposed quarry project.

Three quarries the El-addo limestone quarry, the Kawo Goday sandstone quarry, and the Burhaybe basalt quarry are run by several construction businesses. The researcher was motivated to conduct this study because of the challenges these stone quarries, where mining is the main industry. The way quarrying is done in the country is drawing an increasing amount of public ire. Numerous quarry tragedies and complaints involving quarrying operations, particularly those involving abandoned quarries, have been reported around the nation. All projects typically were supposed to do EIAs before they start, and a lot of study has been done on the rehabilitation of quarries after use, but nothing is done during the quarrying process. The majority of quarry sites are hazardous to work in, and the majority of quarry operators disregard safety and environmental procedures when conducting mining operations. The majority of quarries degrade the site by using explosives during blasting operations.

This study focuses on two key concerns: the implications of quarry mining activities on society and the environment, and how to address and solve these difficulties. By conducting actual independent evidence into the perceived health-related and environmental dangers in the surrounding communities of the quarry mine in the Karan district, this study aims to close these gaps. For reducing the detrimental effects of quarry mining (such as vibration, air blast, fly rock, dust, fumes, and water pollution, among others) that might otherwise lead to a more serious significance rating, a number of management control techniques were developed. Quarry sites are utilized for a short period of time up to a long period of time before being abandoned when they are no longer viable for use. As a result, their recovery process is intricate and challenging, however careful preparation can raise the likelihood of success. The restoration that is carried out in accordance with the site plan's specifications after the site's supply of industrial raw materials has run out is the final rehabilitation. By restoring damaged areas, the overarching goal is to transform the capitalist exploitation and use of natural resources through the ecologically sound practices.

1.2 Problem Statement

In Karan district located in Mogadishu, many construction and quarry related projects have resulted in various hazardous effects. Such include environmental issues like high density in atmospheric dust-particles, flooding, poisonous fumes, noise-pollution, flying pebbles, air blasts, and ground tremors brought about by quarry mining machines. Despite the fact that these quarry projects generate many job opportunities and supply a variety of construction and industrial natural resources, there has been no research on the extent to which these projects have an influence on the environment and community cohesion, particularly in Mogadishu. Without carefully examining its effects, a sustainable mitigation solution is difficult to implement.(Somalia G report ,2018)

Mogadishu is one of the most promising quarry sites of Somalia, offering numerous job opportunities as well as a variety of building and industrial raw materials. However, it has been noted that a number of environmental issues exist, including the excavated site being abandoned and left as wasteland, improper dumping of overburden materials for future rehabilitation, soil erosion and degradation, and the diversion of natural river water flow, which has an effect on groundwater recharge. Additionally, the quarry locations in the research region have serious management issues that include poor mining plans, a lack of ecosystem considerations, insufficient quarrying processes and restoration gearing up, technological and policy enforcement road blocks, conflicts, and other issues that significantly worsen the environment's degradation and socioeconomic development efforts at the district level. As a result, it is necessary to conduct site research to identify the impacts. Without a thorough analysis of the implications, it is challenging to implement a sustainable mitigation strategy.

Therefore, based on the case study region, this study aims to evaluate the effects of improper open - pit mining on the biophysical as well as socioeconomic landscape of Karan district,

in Mogadishu (Somalia 2018). A methodical strategy to the mineshaft mining process must be used to address this problem. This strategy should evaluate any potential environmental effects of the quarry mining activity before controlling and managing ongoing operations to guarantee that the effects are kept to a minimum. These stone quarries, where mining is the primary activity, face a number of difficulties, which inspired the researcher to carry out this study. This study focuses on two key issues: the effects of quarries on society and the environment, and how these problems are solved. By conducting direct experience rigorous studies into the perceptions of both health and environmental dangers in the area surrounding the quarry mine in the Karan district, this study aims to close these gaps.

1.3 Research Objective

1.3.1 General Objective

The main objective of this study is to assess the impact of faulty quarry mining activities on the environment and the nearby community in the study area under.

1.3.2. Specific Objectives

The specific objectives were to:

1. Identify factors influencing improper quarrying activities in Mogadishu, Somalia.
2. Investigating effects of improper quarry mining operations on the surrounding neighborhood,

1.4 Research Questions

1. What are the factors influencing improper quarry mining operations in Mogadishu, Somalia?
2. How does improper quarry mining operations affect the environment and its neighborhood?

1.5 Significance of the Research

This project will advance knowledge of the effects of quarry extraction on the natural and social settings. Additionally, the analysis of the prospective effects gives data on mitigation and the potential choice of corrective actions. It will be easier to investigate and gather information regarding how individuals in mining towns perceive the social and ecological consequences related to quarry mining operations by talking to, questioning, or interviewing the nearby neighbors and corporate employees of the study region.(Dursun Z. S. et al.2012).

The investigation will also contribute to raising awareness of the potential environmental effects of quarries, particularly those that are located near to populated cities. Planners, policy and

decision-makers can utilize the outcome to manage an abandoned quarry properly and turn the quarry site back into a secure location. A correct process for proper ecologically sustainable and friendly quarrying operations will also be provided in this research work to build on the scientific and knowledge gap (Langer et al. 2001).

1.6 Scope of the study

The study's geographic scope is restricted to the Mogadishu quarries, which are in the El-addo, Karan, and Wadajir districts which is also known locally as the "KAAWO" quarry project site, or the Quarries site, despite the fact that there are numerous stone quarrying activities taking place in various parts of the studied area (Kaawo-Godey and El-addo) as shown in figure 1where a significant amount of stone quarrying has been done. The subject's thematic focus expanded to include environmental and socioeconomic issues, including factors, patterns, and effects of changes in land use and land cover, depletion of land and water resources, impacts on other physical and non - physical elements of the biosphere, and effects on livelihood options, income, and economic benefit to the neighborhood and the city (Amarnath C. et al. 2022).

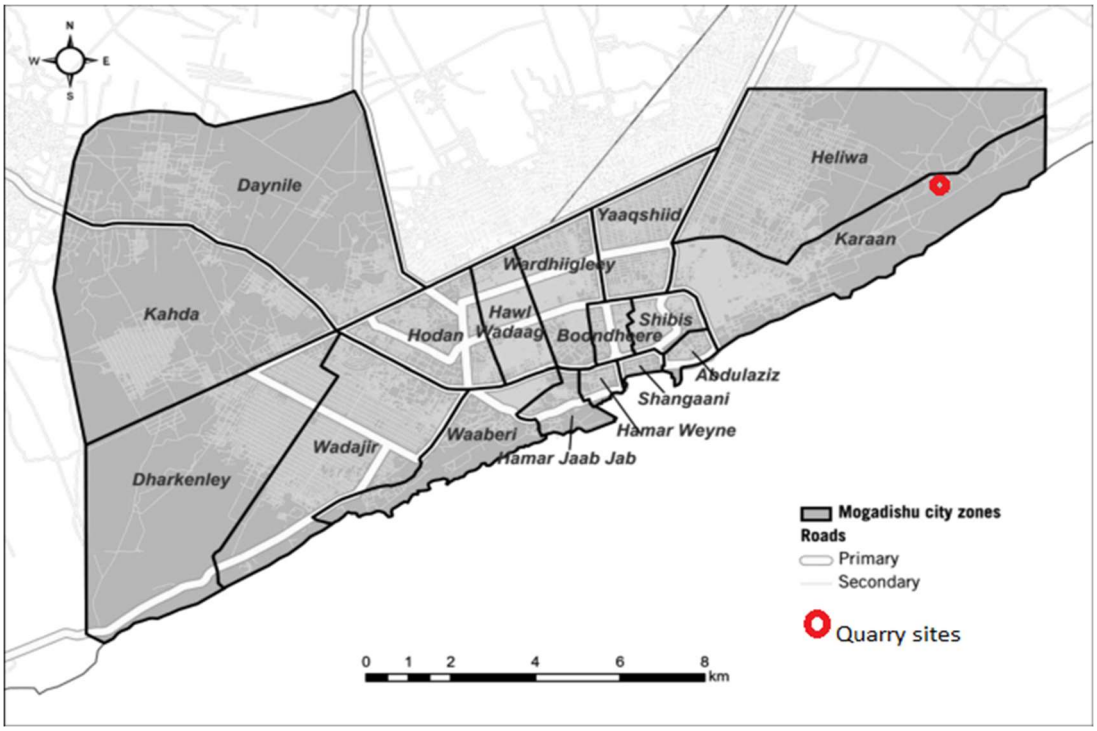

Figure 1 Case study area (Source: Districts of Somalia)

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Occupational health and safety, mining and environmental stewardship, stone mineral extraction and environmental sustainability, social license to mine, environmental license to mine, and rehabilitation of abandoned quarries are the main topics of this chapter. It also covers the history of quarrying, quarrying operations, quarry design, environmental impact of quarry operations, social impact of quarries, and mining and sustainability. The legal frameworks governing mining operations in Somalia were then discussed (Tuija et al. 2022) .

2.2 Common Activities at Quarry Site

A rock quarry is simply a location where large boulders are broken down into smaller ones. The essential procedure is the same, but because each quarry is unique, some of the information in this document might not be applicable to all operations. Many preparations must be performed before the quarry operation can begin. The geologist must first locate a location where there is a significant amount of rock beneath the surface of the earth. Rocks from igneous, metamorphic, and sedimentary sources can then be quarried. Land clearance is the first operating phase in order to access the rock beneath the earth's surface. The property will be ready to start mining the rock once it has been cleared and readied (Washington et al.1999).

Drilling and blasting are crucial for removing the rock from the earth. In order to do blasting, a hole is first dug in the ground, and explosives are then inserted. To ensure the most effective blasting, the explosive is set off. The stone is released from the quarry wall by the explosions that take place when the blast is detonated. To move the rocks, the loose rock from the mine wall is crushed and separated into various sizes before being loaded into huge haul trucks. Between the processing plant and the pit, trucks are constantly moving. In order to reduce large boulders to smaller ones, the rocks have now been removed from the earth and transferred to the processing facility (Jian Zhao 1911). There are also more human-made activities that produce a lot of garbage, such quarrying. Some quarries, like those that produce sand and gravel, don't produce a lot of permanent waste, while others, like those that produce clay and silt, do (Wang, 2007). Environmental harm is still a concern, especially when it comes to contaminated water. Plants have a significant role in the ecosystem, which is the result of the intricate interactions between biotic and abiotic elements of the environment. Dust created by the action settles not only on the ground, vegetation, and trees but also on surface waters utilized for drinking and other domestic purposes(Cunningham et al. 2008).

As time passed, more rock was employed in building projects. It was a good material for constructing castles, walls, churches, and other important structures because it was powerful and weatherproof. Quarrying became more popular as the supply for stone increased. Demand shot through the roof during the Industrial Revolution. The Victorians used stone for all of their major buildings, and with better transportation and new technology, they have been able to meet these rising requirements, most likely with little regard for their environmental impact (Daniel J. et al. 2013).Only countries with a high per capita income as well as low population density have decided to make efforts to regulate the unintended consequences of mining. It makes sense that many less developed nations, such as Kenya, where primary mining sectors are proportionately more significant than in other nations, are reluctant to place unnecessary limitations on their principal sources of wealth and foreign cash. He asserted that most foreign businesses locate their production operations in developing nations where environmental regulations are either limited or poorly enforced, allowing them to easily magnify the environmental harm cost of their production. The most contentious issues in mineral development in developing countries concern their relationship with developed countries as capital and technology providers.

Even though excavation and pulverizing are both hazardous to the environment and to humans, they necessitate constant monitoring of the work environment and the workers. Mining operations harm the environment, which can result in ecosystem degradation, by causing deforestation, vegetation loss, soil degradation, changes in ground water levels, and environmental damage. Development has occasionally come before the consequences of the development process. Utilizing resources is necessary for development, but it does not take the effects of resource consumption on the environment into account. The fact that most quarrying activities do not take environmental concerns into account when designing and building the big project is the cause of the numerous environmental problems related to resource extraction, such as extraction and processing (Akkers et al. 1990). The wants and ambitions of the people who are directly affected in the immediate neighboring communities, as well as the impact on the primary environment, are frequently ignored when projects are sited and carried out, according to (Ayodele & Lameed 2010). In open cast mining and quarrying contexts, there are typically significant land areas present, leaving stagnant ponds or open pits behind.

2.3 Quarrying Operations

Usually for the purpose of producing aggregates and stones, mining activities is an open cast excavation from which quite large and deep layers of hard or soft rocks are taken (Coppin, 1982). The majority of quarrying activities involve drilling, blasting, and smashing of rock resources. The first stage of quarrying is called stripping, and it entails removing the topsoil and subsoil that cover the mineable resources. Subsurface dirt is removed, transported, and redeposited using a wide range of equipment (Langer et al. 2001).Following stripping, the next step is to

excavate or mine the resource, generally using drilling and cutting or other techniques to fragment it into desired size and shape. Following that, the materials are transported to the crusher for the purpose of size reduction before being conveyed to the industry or its final use. The rock may go through various smaller-sized crushers one or more times, depending on the output size.

Conveyor belts are used to transport the crushed rocks throughout the processing facility as they exit the crushers. Screening follows crushing whereby screens are used to divide the rocks into piles of the same size as they are reduced to smaller sizes. The bigger screens let through the bigger rocks, whilst the smaller screens only let through the smaller rocks (Poulin et al. 1994). Rocks move down lengthy, continuously moving assembly lines at the facility to get from one location to another. The conveyors facilitate the efficient movement of rocks, saving both time and expense (Bauer 1991). After this stage, the corporation is responsible for storing the rocks. The stock piles may consist of huge heaps of limestone, gypsum, sandstone, pumice, and other types of rocks. Some stockpiles can reach heights of 30 feet and a 300-foot circumference. Due of its exposure to the elements, the business must be constantly maintained to prevent being washed away by torrential rain. They must take care to prevent the mixing of other materials with them. Bulldozers and front-end loaders can be used to hold the stockpile in place (Kelechi Denis et al. 2021).

2.4 Quarry Design

To make sure efficient and secure locations throughout extraction, restoration, and after use, some fundamental principles should be adhered to all quarries. Before submitting a planning application, the concerns of safety, aesthetics, environmental protection, and the quarry's intended use will be researched and considered in this study. Quarries operate under a stringent planning system. The perimeter of the planning authorization within which a functioning quarry works is referred to as the quarry boundary.

2.5 Environment Impact of Quarrying

The operation of quarries has a wide range of potential environmental effects, which necessarily has negative externalities. These effects include changes to the landscape, changes to the surrounding environment, erosion, habitat loss, a loss of flora and fauna, stability issues, loudness, acoustic noise, dust, security issues, changes to the quantity and quality of water, increased traffic and waste production, and deterioration of the natural drainage system. These issues are common when developing quarry operations.

According to a World Bank working group report on environmental protection, jobs like quarrying, mining, and sandblasting increase the suffering of the poor while also harming the environment (IEG, World Bank, 2008). Additionally, according to Maponga and Munyanduri (1998), quarrying has detrimental effects on the environment during excavation and blasting, transportation, and disposal of waste materials. Destroying vegetation, altering animal habitats,

diverting and obstructing natural drainage systems are all significant environmental effects. The following are descriptions of a few of the effects (Malpass et al. 2019).

2.5.1 Land use change, Land degradation and Impact on land scape

The term "land use" describes how people use land, including any recent changes to or transformations of the land's cover. In contrast, land cover refers to the natural covering that defines a certain area (De Sherbinin , 2002). Quarrying is one of the lands uses that results from the mining of non-fuel and non-metal elements from rock in this regard Chizoro et al. (1997) state that quarrying affects land use policies by creating a conflict between agriculture and quarrying or by coexisting with it, resulting in ongoing disputes over land use. The extraction of land for access roads and mining sites disrupts natural habitats of wild animals, reduces grazing areas, and diminishes sources of plant life for both humans and animals (Chizoro et al. 1997). Moreover, the noise generated by blasting and transportation activities not only impacts residents but also leads to migration from surrounding areas, disturbing the food chain and causing damage to ecological balance.(Darwish et al. 2011) .

Quarrying activities, according to Stehouwer et al. (2006), also place a significant strain on the earth's finite soil and water supplies. As a result, erosion processes occur more quickly, resulting in further harm to existing arable areas. Ecosystems that already exist can be severely altered by quarrying operations, which can also disrupt groundwater and hydrological processes. They have the power to significantly alter the substratum, alter the integrity and patterns of the landscape, destroy natural habitats, stop natural succession, and alter genetic resources.The landscape was mostly used for farming and grazing before the quarries were built, but when quarrying started, a lot of the vegetation was destroyed. Only a few businesses have been successful in their efforts to plant trees. Dust, noise pollution, tremors, and vegetation loss are all effects of quarry activity. Companies that operate quarries have made some effort to lessen these consequences. They strive to reduce the amount of dust at the crushing site and the loading point by watering. Mild explosives and modest noise-reducing equipment are used to control the quarry's noise production.

A crucial task in the building sector is quarrying. It produces the supplies needed for developing and constructing roads. Both the quarrying and other allied sectors, like block construction and drainage material construction, employ a sizable population. Most quarry businesses also work in building; therefore, they are not just engaged in quarrying. Both positive and bad consequences of quarrying are present, however it seems that the negative effects outweigh the positive. The quarries interfere with the efficient running of the local human settlement because they are situated close to homes and even schools. The residential area's health is impacted by the quarries' extensive trash disposal (Sang-Gil et al. 2021).The protective equipment that quarries workers who engage in quarrying activities need to shield themselves from danger as they go about their everyday business in the quarry is lacking. Face masks are required for quarry workers in order to protect them from the dust that is produced during their work. In our case, however, we found that the bulk of them lack the

requisite tools. Some quarry sites don't have sufficient fences surrounding their property, which is extremely dangerous for passing by individuals who could fall into the more than 30-meter-deep quarry pits. Residents who live close to quarries are at risk because of this.

Natural resource exploitation-related disputes are frequently "serious and debilitating, resulting in bloodshed, resource degradation, and the displacement of people," according to Castro and Nielsen (2001), and if unresolved, "may threaten to unravel the entire structure of society." Each party wants to pursue its own interests to the fullest extent possible, but in doing so, they end up at odds with, compromising with, or even working against the interests of the other party including physical features like land form, living components like flora and fauna, abstract factors like lighting and meteorological conditions, and individual factors (human activity) or the built environment, a land scape is the visual characteristic of an area of land (Gerhard, 2003). The environment and the native ecosystems at stone quarry sites are significantly altered as a result of quarry activities. There are effects when the topography's natural contour is disturbed, not just for the nearby communities but also for those next to them.

2.5.2 Noise and Vibration

Earth-moving and processing machinery, blasting, and processing equipment are the main sources of noise all through stone excavation (Langer, 2001). At quarries, blasting can result in vibration, audible noise, fly rock, and dust. Blasting produces vibration levels that are significantly lower than those that can harm a building's structural integrity. Nevertheless, air overpressure and vibration from the ground that travel through the air can cause annoyance by shaking structures and people. Overpressure is accompanied by audible noise (Alloy St. et al. 2019). Noise can cause annoyance and inconvenience to individuals, creating disturbances during their sleep and affecting wildlife. Various places such as homes, educational institutions, medical facilities, elderly care centers, and places of worship are also sensitive to noise. The impact of noise is significantly affected by factors like the origin of the sound, the physical features of the area, the way the land is used, the vegetation covering the ground, and the weather conditions in the vicinity. The effect of noise on the listener is determined by the beat, rhythm, pitch, and distance from the source of the sound.

2.5.3 Dust Deposition and Impact on the Atmosphere

Concern over how air pollution affects human health and the environment is developing on a global scale. Our need for unbiased and reliable information about the quality of the atmosphere we all inhaled air is increasing as a result of increasingly strict legislation and strong societal pressures. Dust and diesel generator exhaust are released into the air during quarry operations. These nonmetallic minerals produce dust during operation through drilling or blasting, trying to load into haul trucks, and transportation to the processing location. The rock processing facility (plant) uses feeders, crushers, screens, conveyors, and bins to transport and process the rock(s). Diesel fuel is

used to power processing equipment (Manisalidis et al. 2020). The surrounding area's air quality would suffer because of this fugitive dust. The dust produced by the quarry operation would harm the health and wellbeing of locals even with the appropriate restrictions in place. Additionally, worsening quarry-related vehicle emissions would have a significant impact on the health and wellness of neighboring individuals as well as the surrounding area's air quality. Local air quality is impacted by outdoor pollution from quarrying operations.

Quarry dust can cause major health issues in addition to polluting the air. Both on the job site and on the highways, quarrying produces dust. Animals, vegetation, and agriculture are typically impacted by dust emissions, though the exact impacts require further study (Netherlands Committee for IUCN, 1996). Animals have been known to inhale hazardous (silica) compounds from dust, while plants and trees have been known to suffer from oxygen deprivation, which can cause the plant disease hypoxia (WRM, 2004). Aqueous sprays and wet methods can be employed to minimize dust release, which is not frequently practiced in quarrying compared to processing. Consequently, individuals residing near quarries and workers in mines could experience negative impacts from dust. The primary potential consequences of dust include visual impacts, soiling of personal belongings such as residences, washing machines, and vehicles, coating of vegetation, contamination of soil, pollution of water, alterations in plant species composition, elimination of delicate tree species, gradual escalation of mineral nutrient inputs, and changes in pH levels.

2.5.4 Impact on Water Resource

Quarrying has a significant impact on the water quality and route (Gunn and Hobbs, 1999). The degree of activities in the quarry has an impact on both the surface and ground waters. If the site is entirely within the hydrological protected area, there could be substantial effects. The extent of the impact on nearby water quality depends more on the soil and rock material being removed than anything else (Richard, 1999).

2.5.4.1 Surface Water Impacts

The impact will be greater if a river, spring, or wetland region is close by to the quarry operation. Depending on the quarry property between one of the operational pit and the production yard, the course of a river or the quality of a spring's eye may alter. Pollutants such total flow settleable solid, turbidity, and total suspended solids can be discharged to surface water as a result of runoff from the quarry yard and pit dehydration (Richard, 1999). These are the main steps being taken to combat surface water pollution. The amount of pollution is determined by the geology of the resource being extracted (Ahmed et al. 2020).

2.5.4.2 Ground Water Impacts

The effects on ground water at the site depend on the soils nearby the quarry, the underlying geology, the quantity of rainfall, the depth of the pit, its closeness to a well and an aquifer, and blasting technique. There will be water seeping in from zone that extends across the entire face of the quarry wall if the overall ground water supply in the quarry operation yard is good. A flow is produced by the side's seeping. Seeps are caused by ground water moving through cracks in the rock that were either created naturally or as a result of blasting.

If there are significant water leaks into or out of the quarry, they can be caused by fractures that are continuous or have the potential to do so. A significant negative influence on ground water is anticipated as a result of expanding quarry operations close to the area where ground water discharges. It is wise to prepare for quarrying so that there is a space between the mined pit and the project property line. Even yet, it is advised to install more dewatering pumps and sedimentation ponds because the increase in rainfall and seepage could be significant in terms of limiting the effects. To lessen runoff and erosion, it is preferable to have enough acreage for handling excess runoff and pit water (Hobbs and Gunn 1998).

2.5.5 Impacts on Biodiversity

The mineshaft operation's effects on biological resources were principally caused by the destruction of vegetated lands, wetland areas, forested habitat, and blended habitat necessary for the planning and building of the new road. Pine and other hardwood trees may cover the forested area (oak, poplar, ash, hickory, and sweet gum predominate). The environment is used by a variety of small mammals as well as local and migratory birds. The beneficial wild life will disappear as a result of habitat fragmentation. The land in the proposed project may be classified as prime forest, a natural area, or a habitat for wildlife. As a result of the operation, everything will be gone. Construction-related environmental effects such as habitat loss, sedimentation, and erosion are generally to be anticipated. Consequently, quarry operations may result in a loss of vegetation and animals

2.6 Social Impacts of Quarry Mining

The assessment of past, present, and anticipated future adverse effects of quarry activity at levels of production is the characterization of the social, economic and cultural aspects of quarry activity, which is quite simple (Melaku, 2007). According to earlier research, the establishment of a quarry causes a change in land use and economic activity, which in turn causes a population growth and alters local residents' customs, cultural beliefs, and values. The operation of the quarry will have a negative effect on these qualities if it is located near an urban center that is surrounded by land used for recreation and homes with high scenic values. Homes, parks, and open spaces

could all see the quarry. As a result of blasting, vehicle emissions, and other mining activities, the quarry operations would worsen the air quality. Residents' health and wellness will suffer as a result of the dust (Assefa and Gebregziabher 2020).

Where rock debris is extracted through blasting and crushing in open mines, the dust effect is considerably severe. When breathing it in, pulverized rock dust appears to be both smearing and healthful. The risk of lung cancer among people exposed to silicic rock dust is rising, according to earlier studies (Guo, 2005). Rock falls that harm nearby properties and endanger human life are more likely to occur as a result of earth movement during blasting operations. As activity ebbs and flows during the working day, so does the noise level. In response to changes in air pressure, which in the case of sound are represented by air pressure waves that cause the vibration to the eardrum and as a result, the human ear generates a very wide variety of responses as indicated by Melaku (2007). The threshold at which noise starts to damage hearing is typically 70 dBA (U.S geological survey 1997). The noise intensity of a heavy city vehicle is 90 dB, which causes very annoying hearing damage (after 8 hours).

Therefore, the quarry operation has greater than these noise levels, which could have really negative effects (U.S geological survey 1997). Blasting is the initial crushing stage used by quarries to produce stone, and it causes seismic amplitude and explosions. Between mines, within mines, and with regard to in-mine instrumentation, the effects of explosions employed in quarry blasting technique vary substantially (Chan, 2005). Infrasound signals are typically produced during blasting operations through seismicity, which can result in property damage, fracturing of buildings like bridges, houses, or other man-made structures nearby, and psychological problems for those nearby. Noises that can be heard and concussion effects that can rattle windows are also affected by air pressure vibrations from air blasts (Hertzer, 2000). According to the World Health Organization, noise can negatively impact human health and wellbeing by causing aggravation, disrupting sleep, interfering with communication, particularly listening, interfering with learning, causing antisocial or aggressive behavior, and causing hearing loss (WHO,1992).

Establishing a buffer zone between residents and the quarry area will lessen the adverse effects of quarry operations on nearby residents. According to James (1998), the minimum separation between workings and residents that has been approved or suggested varies significantly, reaching up to 400 meters for sand and gravel and 300 to 900 meters for hard rock workings. The terrain and environmental sensitivity of the area affect how effective distance is as a control. If the allowable distances are too short, neither operators nor residents will gain much, if anything. The operators will see that the demands of cost and expediency drive them to "risk it" in challenging circumstances. Most of the time, locals will discover that the operator is not very receptive to their complaints and that the conditions are frequently at or above the limit of what is acceptable (Melaku, 2007). Regarding fly rock from blasting, it is impossible to provide a safe distance. Therefore, the main goal must be to stop the production of any fly rock (James, 1998).

2.6.1 Socio-Economic Impacts of Stone Quarrying

Despite the fact that agriculture is still the primary method for reducing rural poverty, small-scale mineral extraction is also playing a significant role in the improvement of rural livelihoods by generating more job opportunities and boosting income (Fellmann et al. 2005). Over 500 million people live in developing nations and work in industries like small-scale surface mineral extraction and quarrying to make a living (Mahmood H. K et al. 2001). Connectivity to natural resources is crucial for determining how people can support themselves in Latin America, East and Southeast Asia, and Africa. The informal sector has emerged as a desirable alternative for addressing basic demands for a living because the formal sectors in underdeveloped nations have very little talent and ability for job development (Ibrahim, 2007).

2.6.2 Income and Employment Opportunities

Quarrying operations generate employment opportunities and contribute to a country's gross national product through the production of goods for local consumption and overseas trade (Bhutan National Council, 2013). The labor-intensive and low mechanization nature of stone quarrying results in the creation of numerous jobs, as stated by Kuntala Lahiri-Dutt (2000). While obtaining precise data on the industry's overall employment contribution can be difficult, it is worth noting that sand stone mining alone employed approximately 2 million individuals in India. The enormous demand for environmental resources brought on by population growth has put a significant strain on such resources, endangering their sustainability. The majority of resources have been exhausted due to overuse of the environment, and the majority of fertile land cannot be repaired (IEG, World Bank, 2008). The poor majority seeking alternate means of subsistence in rural areas are likely to experience worsening health and unemployment issues as a result of this development.

2.6.3 Occupational Health and Safety Impact

The mining and quarrying sector has a long history of posing serious risks to occupational health and safety. Netherlands-marketed jewelry's sustainability (CREM, 2005). Accidents that result in death still commonly occur in quarries and mines nowadays. The most frequent occupational risks related to stone quarrying include:

- ✓ Vital accidents
- ✓ Bodily wounds that necessitate medical attention
- ✓ Work-related illnesses, such as respiratory conditions like silicosis and tuberculosis caused on by inhaling fumes.

The effects of air pollution including respiratory challenges, silicosis and tuberculosis are common work-related illnesses in the natural stone industry (or silica-tuberculosis). Due to repeated exposure to silica dust, a significant number of quarry workers develop silicosis or tuberculosis. Environmental damage caused by excavation, blasting, and the discharge of dangerous chemicals,

according to Langer (2001), is thought to be a major contributor to the estimated 4 million deaths per year from severe respiratory issues in developing nations.

2.7 Mining and Sustainability

The possibility of sustainable mining is theoretical but extremely improbable. If consumption is dropping and the rate of decline is larger than the current rate of consumption, the use of non-renewable resources like metals and minerals may be sustainable. Practically speaking, sustainability in mining is a far-off goal, but a lot of mining firms and business groups are attempting to adopt more responsible environmental, commercial, and social practices. The minimizing of environmental consequences, the implementation of the polluter-pays concept for environmental damages and liabilities caused during and after mining operations, and long-term land-use planning (further than the life of the mine) are all significant environmental factors.

Langer (2001) asserts that environmental harm from planning for the transition to alternative employment following the closing of the mine, ensuring the equal distribution of money, and making the appropriate expenditures in community development are all examples of economic and social responsibility. Government mining subsidies could fundamentally change a company's ability to turn a profit. In general, Mine Company's obligations to worker health and safety as well as respect for fundamental human rights, cultures, customs, and values fall under the umbrella of social responsibility. Many well-known mining corporations today make their guiding ideas clear in their Corporate Social Responsibility (CSR) plans. As local populations grew more hostile to the dangers posed by irresponsible mining, this trend began, and the practice has since evolved into a yardstick by which performance is evaluated. Investors who were concerned and placed a higher priority on sustainable investments than quick profits identified these CSR methods. Today, there are several success examples of large and small businesses collaborating with indigenous communities, conservationists, civil society organizations, and governments to improve livelihoods and create benefits while protecting the environment and cultural heritage. With the help of this toolkit, more mining businesses will be able to share their own success stories while also promoting increased openness and communication.

2.7.1 Stone quarrying and Sustainable Development

Following the adoption of the phrase "sustainable development" as an official UN objective in the 1987 Brundtland Commission report titled "Our Common Future," the idea became widely known. The World Commission on Environment and Development (WCED, 1987), gave a broad definition of the term as development "meeting the requirements of the present without jeopardizing the potential of the future to satisfy its own needs." Since 1987, there have been numerous attempts to define sustainable development more precisely, which has sparked an expanding discussion on how to put the idea into practice. Theoretical aspects of managing non-renewable resources (Selman,

2000); a strategic scale of effective supply (Kelvi, B. et al. 1996). The governmental site-specific threshold for the effects of operating a specific deposit on the environment, are the three levels at which the notion of sustainability in the context of minerals, such as mining, may be seen to begin the game (UN Summit et al. 2016).

The conceptual intensity essentially embraces an organizational basic concept that challenges the very concept of extraction, the right to quickly take common mineral resources out of the ground, and the pursuit of progress or personal wealth in order to establish issues of generational equity and ecologically sustainable custodianship through rules and practices, progressive implementation of conserving natural resources, fundamentals, and empowering expedited advances in the discipline. Supply and demand dynamics typically dictate discussions about sustainable mineral development at the strategic level (Cowell and Owens, 1996). The design of the quarry network in relation to market hubs and growing zones, as well as their connection to transportation infrastructures, are major issues in the discussion of how to lessen the environmental impact of mining, refining, and transportation. Regulations and the limitations of project design in site-specific contexts determine the extent of environmental effect at a specific location (Tiess, 2007). In this regard, environmental impact assessment [EIA] can be considered as a crucial SD tool that helps raise awareness of important environmental issues, examines the duration and cumulative impacts of externalities, and ensures the implementation of the most sustainable outcomes technically possible.

2.7.2 Social License to Mine

In order to assure economic viability, profitability, and continuity with regard to their operations and potential local and community conflicts, mining firms are adopting the idea of the social license to mine and operate in growing numbers. Even though there isn't a universally accepted definition of the phrase just yet, many environmental NGOs understand the phrase "social license to mine" to refer to the local community's approval of a project before it is approved or developed. As stated below (Lassonde, 2003), the mining industry defines the concept: "Social license is the acceptance and conviction by society, and particularly our local communities, in the value creation of our actions, such as we are permitted to access and extract mineral resources.

Most often, going to a government office, filling out an application, and paying a fee won't be enough to get you your social license. More than just money is required to truly integrate with the areas in which you operate. Environmental impact assessment (EIA) and social impact assessment (SIA) are frequently used synonymously when discussing social permission to mine, as in Shepherd's (2008) definition: We put forth the following definition of "social license": "We propose that the term 'social license' refers to a comprehensive and thoroughly documented process whereby local stakeholders and other vested interests identify their values and beliefs as they participate in the scoping of the environmental impact assessment of the proposed project and in the identification of the social impacts of the project. The International Finance Corporation, the World Bank, the

European Bank for Reconstruction and Development, and other development banks and financial organizations are aware of the necessity for social licenses to mine. A variety of principles and recommendations regarding the inclusion of social issues and a human rights-based approach into the operations of the extractive industries have been produced by these organizations and such practitioners as the International Council on Mining and Minerals. They have created and uphold investment criteria based on these tenets that encourage socially and environmentally responsible mining across their investment holdings.

According to a latest World Bank report (Extractive Industries Review, 2003), operations in the extractive industry may seriously harm the environment and the surrounding community if there are insufficient environmental regulations and laws, as well as if governments are unable to effectively monitor what is happening. The research claims that the absence of reliable and widely available grievance channels exacerbates this harm, reduces community confidence in the developers, and leads to unresolved opposition that, in some circumstances, lasts for 30 to 40 years and leaves a legacy of mistrust. The World Bank's solution to this problem includes a recommendation for a comprehensive, multifaceted assessment strategy that analyzes the cumulative effects of initiatives and the socio-economic connections to environmental concerns.

2.7.3 Environmental License to Mine

The findings of environmental impact assessments are confirmed by public authorities, who also issue environmental licenses and permits for the use of natural resources. These licenses and permits typically call for the operator to comply with specific operating requirements and use restrictions as well as to put in place specific measures for the containment, minimization, and avoidance of significant environmental impacts. For instance, a mining environmental license may place restrictions on how waste is disposed of as well as on emissions and releases into the environment. It may also demand stringent containment measures. The license also stipulates an oversight system whereby the public authority judges whether the operator is adhering to the license's requirements in addition to the operating conditions. When requesting an environmental permit, the applicant adheres to the administrative processes established by the public authorities and provides any necessary documentation. For their particular purposes, the relevant public bodies may make specific information requests, and administrative procedures typically offer the public a chance to participate. The public authorities then assess the data that the applicant has provided. Countries may have different information requirements, administrative structures, and public involvement, but the overall plan is the same(Sharpe et al. 2018).

An essential component of the decision-making process for the issuance of a license is the preparation of an environmental impact assessment, which is essentially the applicant's disclosure of information to the public authorities. International consultations should be held for mining projects that could have an impact on transnational environmental issues, and the parties involved

should be informed (Extractive Industries Review, 2003). Although there are well-established standards and procedures for submitting environmental impact assessments, each assessment is specific to a particular set of circumstances, and the authorities evaluate the submissions in light of those circumstances. The authorities issue an environmental license to mine after approving an applicant's EIA. The administrative entities that grant licenses and the competent authorities may be centralized or decentralized. In centralized systems, environmental issues are managed by a single administrative agency, sometimes in conjunction with regional offices to oversee various regions. The national government plays a minor or no role in decentralized systems, while the regional governments are in charge of issuing licenses. Decentralized systems may require cooperation between various public agencies but tend to allow for greater public participation and tend to be more transparent. In both systems, the legitimacy of the public participation process is essential since, without the actual support of the local community, an environmental license to mine is insufficient (Extractive Industries Review, 2003).

2.7.4 Rehabilitation of Abandoned Quarry

Quarrying is a temporary use of land that can be mitigated by effective quarry rehabilitation. Careful planning is necessary for quarry restoration in order to reduce environmental harm to wetlands, forests, and landscapes. As portions of a quarry are extracted concurrently with activities, progressive restoration happens in stages. The establishment of naturalized landscapes that are planned for biodiversity and are harmonious with the nearby areas should be a priority in quarry rehabilitation. Since quarrying will be done using open pits or excavations, slope stability in the quarry and waste rock will be the key concerns during closure (ANERA, 2002).

In order to improve biological resilience and sustainability in relation to human uses and cultural elements, the goal of restoration may center on diversifying current circumstances. One example is a park where continuously mowed grass might be diversified with meadow and wood land associations. Additionally, restoration goals express proactive suggestions for how to bring a degraded site back to ecological health while maintaining compatibility with past and present human activities. Setting goals offers a clear direction for what should be done at the quarry site. What steps should be taken to save important features, what restoration work might be required to get them back to a healthy state (such as natural regeneration, managed succession, community planting), and what design strategy should be used for both present and future management.

Restoring biological diversity and resilience to a place and its life processes that have been severely disrupted or destroyed, typically by human interference, is the goal of restoration. One of the most significant environmental issues of our time is the need for restoration, which results from a variety of factors such as a growing understanding of how natural processes affect urbanization, its implications for sustainability and quality of life, as well as community concerns and commitments to repairing past environmental wrongs. Restoration, in its most basic sense, is the process of restoring

disturbed native communities to their pre-disturbed state. In reality, nevertheless, these objectives are impossible to accomplish in settings where human interference has greatly complicated the environment.(Neri and Sánchez 2010)

2.7.5 Land Scape Restoration

The natural and cultural characteristics of a region those underlying characteristics and circumstances that set one location apart from another should be reflected in landscape restoration. The landscape plays a significant role in the public interest in the cultural, economic and environmental, environmental, and social fields. It is a resource that is conducive to economic activity, and its management, protection, and planning can help create jobs. The landscape also helps to shape local cultures and is an essential part of the natural and cultural heritage, promoting human well-being and securing a community's identity; it is a crucial component of the quality of life for residents.

In general, landscape is an important component of personal and societal well-being, and everyone has rights and obligations regarding its preservation, management, and planning (Carlson E. 2003). This is crucial to the restoration process since it relies on reintroducing native elements to the local and regional landscape. Understanding the unique characteristics of a site, including its geology, soils, and microclimate, as well as its plant populations, fauna, and historical features, is crucial. The diversity, excellence, and character of the former are ultimately determined by the latter. A site's physical, biological, or cultural characteristics that are noteworthy locally or regionally may be discovered through detailed examination. Protecting them should be the main goal of restoration projects. Restoration methods must concentrate on environmentally self-sustaining solutions that require the least amount of human intervention in an economic environment with shrinking budgets. Therefore, strategies that mirror natural processes have a higher chance of success than ones that demand a lot of time, energy, or money. Important lessons for creating natural areas can be learned from the natural regeneration of diverse biotic communities on disturbed lands (ANERA, 2002).

It is usually recommended to plant native species sourced from nearby sources in order to preserve biodiversity and repair abandoned quarries. Human uses must be accommodated in restoration designs where they are likely to happen. Uses can be regulated and restricted to the proper regions with the use of trails, boardwalks, viewing platforms, and activity zones. To prevent sabotaging restoration efforts, it's critical to identify patterns of human activity during the planning stage.(Christopher M. et al.2009)

2.8 Legal Frameworks in Somalia Mining Activities

Federal and regional environmental bodies in Somalia republic are required to comply with environmental laws (mostly drafts) and regulations. The following are some important legislative frameworks:

2.8.1 The Constitution of The Federal Republic of Somalia

Environmental rights and goals have been explicitly taken into consideration for the execution of policies and other legislation that control environmental protection activities in the constitution, a national guiding principle. In this constitution, the following significant points were highlighted. Every person must have access to a healthy and secure living environment, and the government must make every effort to provide this. Any development program shouldn't be designed or carried out in a way that endangers the environment.

In Somalia, there are two main types of environmental governance systems: the conventional communal systems (Xeer), which have their origins in colonial and pre-war law, and the government structures, which also include a recently proposed environmental management statute that has not yet been passed. Due to the postwar structures' heavy reliance on the Xeer and the clan system of government, the distinction between the two can occasionally become hazy (Gundel, 2006). With regard to managing natural resources, this is definitely the case. Nearly 50% of the land in northern Somalia (Puntland), which is subject to customary law, appears to be permanent pasture (Dullo, 2011). Across all of Somalia, permanent pasture makes up between 46 and 56 percent of the land area (Vargas et al., 2009). Forest makes up around 14% of the land, while cultivation-ready land makes up about 13%. (UNEP, 2005). Land has traditionally been considered a common good under customary and international treaties (Raslin S et al. 2021).

2.8.2 Mining Policy of Somalia 2020

According to the national mineral resources policy, "the Somali government places a high focus on protecting and safeguarding the environment." Because mining operations can have a negative impact on the environment, it is necessary to build a legislative framework that forces those who own mineral rights to operate in accordance with best practices for environmental standards. The surface and ground water systems, the tangible land materials such as the soil, rock stability, forest destruction, spillage of containing high toxin levels, the air, noise, dust, and the loss of the area's aesthetic value are the common environmental factors to be considered in the development of exploration activities.(Geoffrey R. et al. 2023)

2.8.3 Mining law of Somalia

The following primary activities have been made illegal by the Federal Republic of Somalia's draft mining code and regulations:

a) Unless the licensing authority decides differently, any mining operations within 100 meters of an archaeological, cultural, religious, or public building, a railway, a highway, an airport, a dam, a reservoir, a factory, or any other government facility will be granted a license.

b) Article 78 of the Code of Federal Regulations stipulates that a contracting officer must, to the greatest extent practical, avoid, minimize, mitigate, and remediate impacts to the significant role played by the conduct of Mineral Activities, including by rehabilitating the land that is the subject of the License Area.

c) Article 76, which mentions the quarry authorization area, also specifies that the area in relation to a quarry and building supplies authorization shall not exceed one (1) hectare and thirty (30) meters in depth. If the Quarry and Building Supplies Authorization Holder has complied with all of its obligations under this Law, the Regulations, and the terms and conditions of the Authorization, the Bearer may, in accordance with the requirements of this Law, grant all of its Permit Area to the Ministry of Petroleum and Mineral Resources.

2.8.4 Environmental Policy of Somalia

The government's environmental policy aims to improve everyone's quality of life by fostering sustainable development through effective green supply chain management practices. In order to accomplish these objectives, a thorough environmental management plan must be created based on the anticipated effects and in accordance with the aforementioned policy provisions and requirements, which include:

1. Considering the project's effects on people and the environment;
2. Understanding the significance of consulting the local population;
3. Finding a balance between relatively brief economic expansion and long-term environmental impact;
4. Sustainable resource management and proper waste disposal.

2.8.5 Draft Environment Management Bill

The Act's guiding principles are comparable to those found in Somalia's National Environmental Policy, and it particularly mandates the following items in regard to the environmental and social implications of quarry mining operations:

(i) Article 61 of the draft title Environmental and Social Impact Assessment states that conducting an environmental impact assessment prior to starting a project is required, regardless of whether an approval, permit, or license has been granted under this Act or another law that is currently in effect in Somalia.

(ii) The section of Article 62 that refers to Monitoring of Environmental and Social Impacts states that "Any person, being a proponent or a developer of a project or undertaking, to which environmental impact assessment is required, shall undertake or cause to be undertaken, at his own cost, an environmental impact assessment study."

(iii) Article 63 Procedures for Environmental Impact Assessment stipulates the kinds of

projects, developments, and activities (including major project definitions) that, if undertaken within Somalia, shall require a prior environmental impact assessment, or such an assessment at any time during the establishment or operation of a project, development, or activity.

(iv) The bill's Obligation to Remediate Article 69 states: "The member states shall guarantee that polluted sites are remediated if such sites result in adverse effects or nuisances or if there is a concrete danger that such effects may occur." The Directorate compiles an openly available list of contaminated sites. If the person liable is unable to design arrangements and more initiatives to be conducted out, if the person liable is unable to act despite being reminded and given time to act, or if the person liable fails to act despite being given notice and the opportunity to act, the Directorate may investigate, monitor, and remediate contaminated environment themselves or instruct others to do so.

(v) According to Article 75 of the Bill Prohibiting Solid Waste Pollution, as follows:

- ✓ No one shall dispose of, dump, or leave any litter on any land, coastal zone, or water surface, street, road, or site in or on any place to which the public has access, unless in a container or at a place that has been specifically designated, made available, or set aside for such purpose.
- ✓ The local government or its designee is in charge of maintaining any location to which the public has access, and they must always make sure that trash cans or other locations are available that are typically adequate and suitable for the public to dispose of litter.
- ✓ Anyone in violation of sub-47 article (1) who discharges, discards, dumps, or leaves any trash on any land, coastal zone, or water surface, street, road, site, or anywhere else in the environment is guilty of an offense and faces a maximum punishment of 500,000 SO SH, up to 15 days in jail, or both.

(vi) The member states are responsible for the management and disposal of garbage generated inside their individual states, according to Article 74, which is titled Waste Management.

1. The environment of one state cannot be harmed by garbage produced in another.
2. Member states must work together to manage and dispose of trash in circumstances where there is an interstate impact.
3. Disputes between states must be resolved by the parties involved.
4. If they can't come to an agreement, they must present the Directorate with other ideas.

The Directorate has the authority to: identify the locations (source) from which waste has been generated; direct the source state to act to cease the pollution; and decide on compensation for

the aforementioned victims. This takes additional suitable action to resolve the conflict. The Environmental Impact Assessment study must be completed before major development programs, plans, and projects of the private or governmental businesses are approved for implementation, according to this act. The Act also offers a legal foundation for efficient ways to coordinate and incorporate economic, cultural, social, and environmental factors into planning and decision-making processes, thereby fostering ecological sustainability.

2.9 The conceptual framework

The following chart indicates the conceptual framework, and the vital independent variables determining a good working, sustainable and ecologically friendly quarrying and mining project plan.

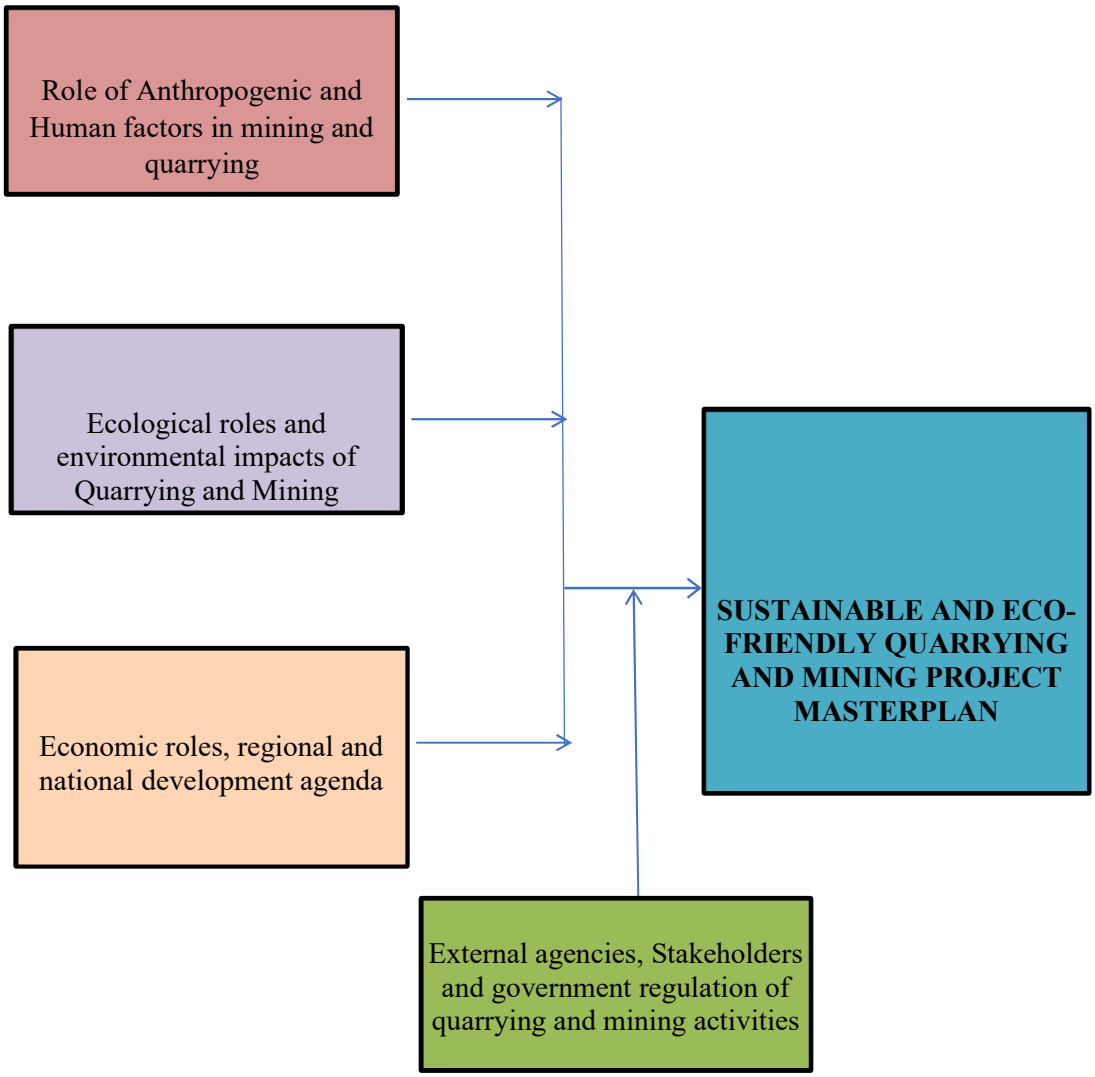

Figure 2: Conceptual framework

CHAPTER 3
METHODOLOGY

3.1 Research Design

To gather the required data for this study, both quantitative and qualitative methods were employed. Quantitative surveys are appropriate when a researcher wants respondents to provide numerical input. They are simple to compare, aggregate, statistically analyze, tabulate, and present using charts. The researcher can quickly gather a range of viewpoints from various respondents by using closed-ended questions. However, the depth of responses from short questionnaires is lacking. Though mixed methods research, which uses the data gathering associated with both forms of data, is expanding due to the rise and perceived legitimacy of both qualitative and quantitative research in the social and human sciences (Creswell, 2022).

The study used descriptive research to explore and analyze the facts and realities of what is occurring in the field or the study region. This was done using a mixed methodology, as the qualitative technique seeks to describe phenomena with the help of rich contextual data. This assisted in locating data that was difficult to quantify and could be collected by interview, questionnaire, and observation, whilst the quantitative method was employed to corroborate the qualitative method. The open-ended questions in the questionnaires were created to elicit opinions about how quarry mining activities are seen by the public and how they affect the environment and people's quality of life in relation to the socio-demographics of quarry employees and the surrounding areas.

3.2 Data Collection Method

A lot of time and money are needed because of the research area's high population. This led to the introduction of a sampling technique, in which a fixed number of people were chosen to represent the entire population of a specific area. In order to choose the respondents, the study used a stratified random sampling procedure. Within the population under study, this form of sampling reveals distinct groups. There are three strata: quarry workers, local residents, and the quarry company. In order to get the necessary representation of different subgroups in the population, stratified random sampling, according to Mugenda (2008), is helpful. In order to ensure that the majority-belonging sub-groups are fairly represented, this technique was used. Then, a random sample was chosen from each stratum, and the sample size for the quarry workers was raised to six from each quarry by choosing a small number of respondents. To gather respondents from each housing complex for the locals, five dwelling units were used; the proportion from each category was determined by the expected population for each unit.(Workman and Theal 1997)

3.2.1 Selection of the Study Area

The study area was chosen using a technique called purposeful sampling. Due to the high number of employees and fact that Mogadishu quarry project sites are one of the key quarry sites for the production of stones and other construction raw materials.

3.2.2 Population Sample Frame

Because of the unique characteristics of the respondents in the study area, the population was divided into three sample frames: the quarry workers, the majority of whom are migrants, the local residence community, which includes residents who have lived in the study area for a significant amount of time, and the EPA, which is in charge of inspection and the enforcement of relevant regulations. With regard to population size, the Mogadishu quarry project, which was chosen as the study region, had 132 quarry workers and around 690 workers with more than a year of work experience in the manufacturing process. The district administration informed me that there were approximately 64 households residing in the area. A total of 80 households were counted during the observations at site, nevertheless. I consequently chose the largest size I could find. Due to this, there are 80 resident communities and 132 employed quarry workers in the research region (Shona et al. 2019).

3.2.3 Household Sampling and Sample Size Determination

3.2.3.1 Sample Size Determination

Participants in this study came from a variety of groups concerned in social responsibility and environmental protection. The Mogadishu quarry area, quarry workers on the job sites, residents of the Karan and Wadajir districts, some employees of the Ministry of Petroleum and Mineral Resources, and the Environmental Protection Directorate were the focus of the study. The number of responders in a sample from a finite population can be calculated using a variety of ways. Therefore, I used the Slovin's formula in this work to determine the sample size (n) from each sample frame's population (N) .

$$n = \frac{\mathrm{N}}{1 + Ne^2} \ldots\ldots\ldots\ldots\ldots\ldots . equation\ 1$$

Where:

n =is required sample size,

N =is total population in the sampling frame,

e = (0.1) is the precision level with 90% of confidence level.

Therefore, based on the formula given the sample size in each frame is determined as follows:

- For quarry employees N=132, n=56
- Local residence community N=80, n=44
- Environment protection directorate N=12, n=10

3.2.3.2 Sampling procedure

Various methods are used, depending on the type and structure of the data source that is available, to choose the sample household from each sample frame. As a result, for the community organizations population sample frame, choose the first house from one edge before making systematic choices every three houses. A project management office is present on the quarry job site, along with four coordination offices situated below the main project office. To select a sample of households from the coordination offices, a snowball sampling method was employed, as described by Berg (1988). This method involves identifying 14 individuals from each coordination office and utilizing a chain-like approach, assuming that connections or referrals between the original sample and others in the population can be made. Despite the availability of a registration book containing the names of quarry workers, I randomly selected individuals from the entries (Ben Wisner et al. 2011).

3.2.4 Data Sources and Methods of Data Collection

Purpose data collection procedure involving collation of both primary and secondary sources of data were utilized.

3.2.4.1 Primary Data sources

The cross-sectional survey's basic data were collected through questionnaires, interview or conversations and observation.

a) Questionnaires

Data utilizing both open-ended and closed-ended questions, questionnaires were distributed to the local resident population, quarry employees, Environmental Protection Office state department, and Sub City of Town Administrations. Respondents can freely express their opinions and ideas without fear of repercussions while answering open-ended questions, which helps us gather enough data to meet the goals of this study.

However, in addition to taking less time, closed-ended questions made it simpler to process factual information and analyze data. These respondent groups were given questionnaires to fill out, asking them about their opinions and perceptions of how quarry mining operations affected them personally, their health, and the local area's physical

environment. Environmental planning solutions for a sustainable quarry management program are based on these fundamental planning principles.

b) Key Informant Interviews

conducted extensive interviews with individuals from different offices, each with unique roles, experience, skills, knowledge, and expertise. The purpose was to collect data on the impact of quarry operations on the community's livelihood, management issues, vulnerabilities of the land, major challenges faced by the quarry program, reasons behind changes in the natural environment, and potential recommendations from community members and quarry owners to address the obstacles to sustainable development..(Azad et al. 2021)

Table 1: Key informants working organization and expertise composition

Organization	**Number of key informants**	**Professions**
construction enterprise environmental department office	4	Geologist, Environmental expert, and Urban planner
Construction stone production project office	12	Management,Geologist, surveyor, safety officer, Site production manager, drilling and blasting crew
(Construction Company) production office	3	Management and Economics
EPD	6	Geographer, environmental planning and landscape design
Wadajir District Administration	3	Geologist, HR-manager,
Karan District administration head	1	Chemical engineer

c) Observation

Observation was crucial since it gave background knowledge about the setting where the investigation was conducted. To corroborate the basic data that had been acquired and to be able to better grasp the events in their natural settings and define the nature of the issue, a significant amount of personal observation was made. I gathered non-verbal information through observation in addition to interviews. According to the study's goal, the observation was conducted using a checklist and personal judgment. This data was compiled into a checklist that covers topics such as the current state of the quarrying operation, the effects of the quarry problem on the ecosystem that already exists, the site's drainage pattern, particularly affected or problematic areas, the condition of the river bank, the state of the natural waterways, the vegetation cover, the state of the rehabilitation effort, the working conditions of the workers, the effects of the quarry problem on society, and other

relevant issues in the study area. Photos, sketches, and notes were used to record the observable information.

3.2.4.2 Secondary Data `

Additionally, pertinent secondary data had been gathered from a variety of sources. In particular, literatures, published reports, and unpublished sources from federal institutions, as well as the legal frameworks for mining operations in Somalia (policy, proclamations, and regulations of mining activity), regional state EPAs, Mogadishu City EPAs, NGOs, documents, and the academic community, were heavily used. The influence of quarry mining activities on society, the physical environment of the area, and sustainable quarry rehabilitation planning and development were also explored. These topics were covered in literature reviews and Internet searches for best practices from a few different nations.(Vedantu et al.2023)

3.3. Data Reliability and Validity

Reliability is the degree to which a measurement can be reproduced when evaluated by different people on different occasions in different circumstances using alternative devices intended to measure the structure or capacity to reflect what is being assessed. It can also be expressed as the consistency or reliability of structural measurements (Hughes, 2015). This essentially means that if someone else did this study under the same conditions, the results should be the same. On the other hand, the capacity to evaluate what is intended to be measured is defined as the validity of the test, according to (Taherdoost, 2016). Working together with my research assistants to highlight a validation approach to project design and instrumentation early on ensures the validity of this data collection instrument. Data reliability and validity in this study was assessed by conducting reconnaissance survey and interviews with respondents to validate and ascertain whether the questionnaire tool guides and responses obtained provide accurately and reflect respondent expectations and viewpoints. Face validity describes the researcher's opinion of the instrument's presentation and applicability.

3.4 Data Analysis Method

The non-spatial acquired raw data was edited, , classed, and tabulated by the researcher in order to meet the study's objectives and to address the research questions. This prepared the data for analysis using SPSS and Micro Soft Office. Methods of qualitative and quantitative analysis were used to examine data from primary and secondary sources. The Microsoft Excel program was used to compute data with a quantitative nature, such as average, percentage, and similar. When describing the socio-demographic traits, descriptive analysis was utilized (mainly in the form of tables, bar charts and pie charts for visual expression (Fiona M et al.2019) .

CHAPTER 4
RESULT AND DISCUSSION

4.1 RESULTS

The study's findings and interpretation are discussed in this chapter. the data was analyzed using the Statistical Package for Social Sciences (SPSS), which produced frequency tables, charts, and descriptive statistics. The quarry site is surrounded by residential neighborhoods, including a large number of households. A questionnaire and an oral interview were used to collect information from quarry owners, quarry employees, and locals. In the Karan and wadajir districts of Mogadishu, the study focused on seven operating quarries. (Ramella et al. 2006)

4.1.1 Descriptive analysis

Table 2 Demographic trends (Gender):

	Frequency	Percent
Male	54	49.1
Female	56	50.9
Total	110	100.0

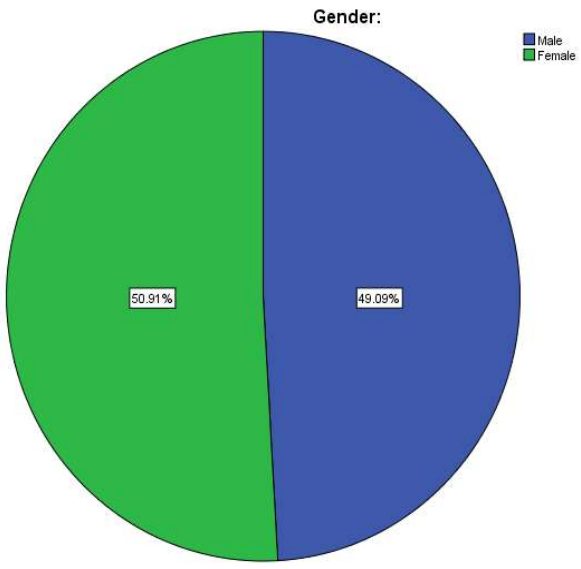

Figure 3 Demographic trends (Gender)

Based on the provided data, there were a total of 110 respondents. Out of these, 54 respondents (49.1%) identified as male, while 56 respondents (50.9%) identified as female. This information shows the gender distribution among the respondents. It indicates that the sample was fairly evenly split between males and females, with a slightly higher representation of females (50.9%) compared to

males (49.1%).

4.1.2 Age Distribution of Respondents

Table 3 Age distribution:

Age Category	Frequency	Percent
18-25 years	16	14.5
26-35 years	53	48.2
36-45 years	11	10.0
46-55 years	17	15.5
Above 55 years	13	11.8
Total	110	100.0

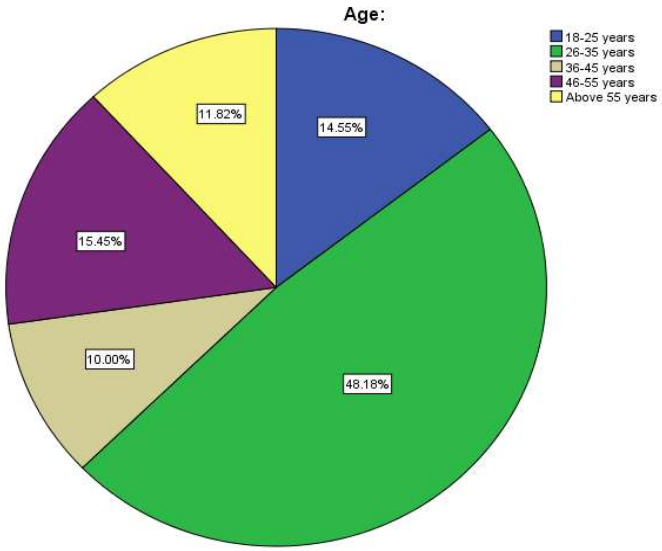

Figure 4 Age distribution

Based on the data provided, the age distribution of the respondents is as follows:

- 18-25 years: 16 respondents (14.5%)
- 26-35 years: 53 respondents (48.2%)
- 36-45 years: 11 respondents (10.0%)
- 46-55 years: 17 respondents (15.5%)
- Above 55 years: 13 respondents (11.8%)

The total number of respondents is 110, with each age group representing a different percentage of the total. These results indicate that the majority of respondents fall within the 26-35 age range, accounting for 48.2% of the total. Other significant age groups include 18-25 years (14.5%), 46-55 years (15.5%), and above 55 years (11.8%). The smallest age group is 36-45 years, representing 10.0% of the respondents. It's important to note that these results are specific to the

surveyed population and may not be representative of the overall population.

4.1.3 Occupation of the respondent

Table 4 Occupation:

Respondent category	Frequency	Percent
Quarry worker	27	24.5
Quarry owner/operator	52	47.3
Local resident/community member	25	22.7
Environmental activist	6	5.5
Total	110	100.0

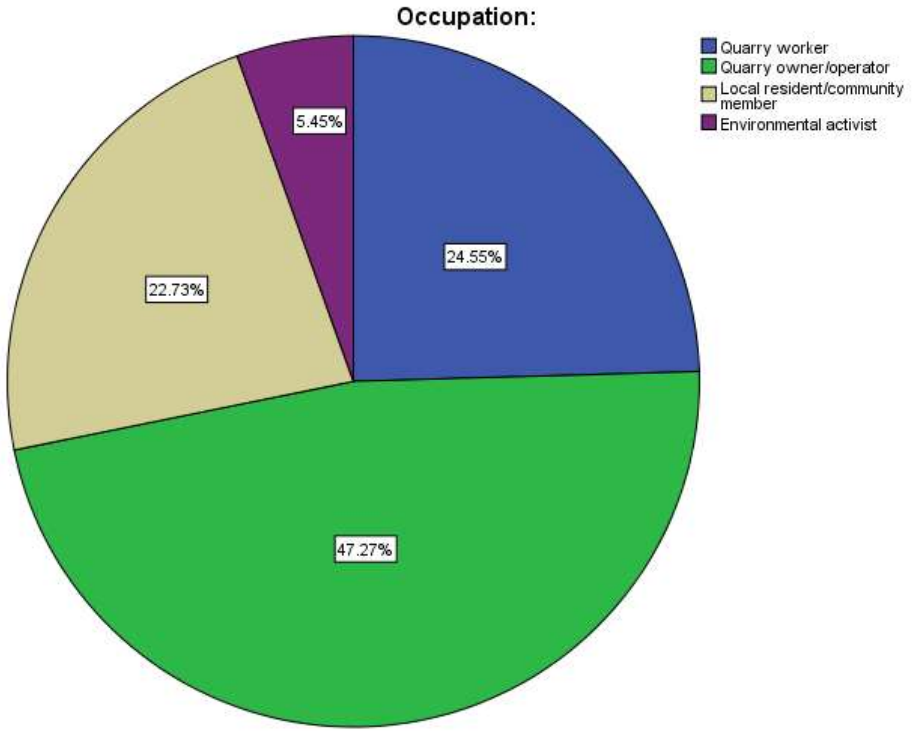

Figure 5 Occupation

Based on the provided data, the occupation distribution of the respondents is as follows:

- Quarry worker: 27 respondents (24.5%)
- Quarry owner/operator: 52 respondents (47.3%)
- Local resident/community member: 25 respondents (22.7%)
- Environmental activist: 6 respondents (5.5%)

The total number of respondents is 110, with each occupation group representing a different percentage of the total. These results indicate that the majority of respondents are quarry owners/operators, accounting for 47.3% of the total. Other significant occupation groups include

quarry workers (24.5%) and local residents/community members (22.7%). The smallest occupation group is environmental activists, representing 5.5% of the respondents.

Table 5: Rating level of awareness among quarry workers and operators about proper mining practices

Classes	Frequency	Percent
High	38	34.5
Moderate	28	25.5
Low	23	20.9
Not sure	21	19.1
Total	110	100.0

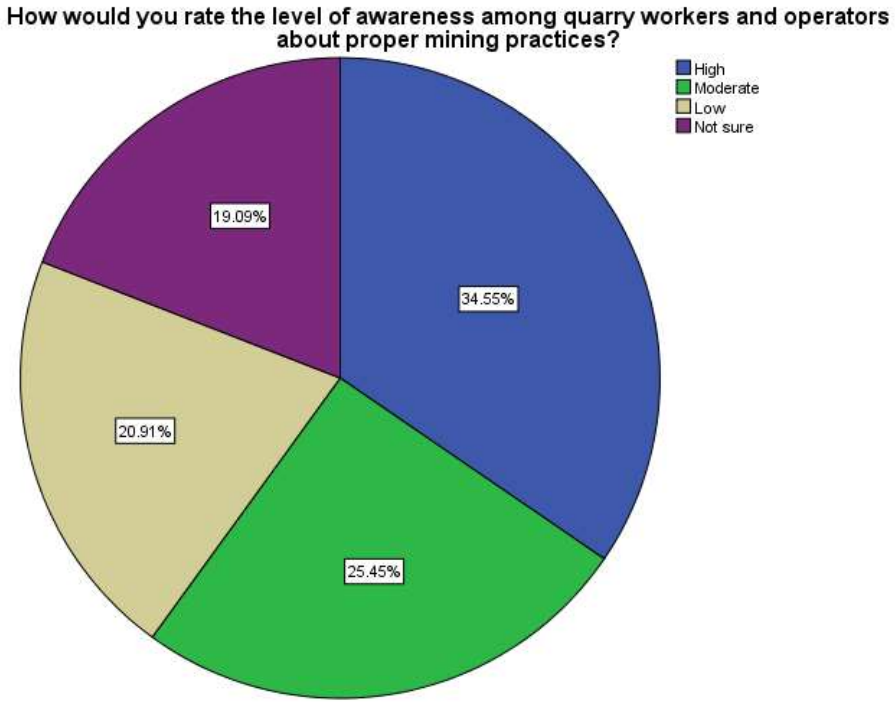

Figure 6 Rating the level of awareness among quarry workers and operators about proper mining practices

Based on the provided data, the respondents were asked to rate the level of awareness among quarry workers and operators about proper mining practices. The rating categories and their corresponding frequencies and percentages are as follows:

✓High: 38 respondents (34.5%)

✓Moderate: 28 respondents (25.5%)

✓Low: 23 respondents (20.9%)

✓Not sure: 21 respondents (19.1%)

The total number of respondents is 110.

These results suggest that among the respondents, 34.5% believe that the level of awareness

among quarry workers and operators about proper mining practices is high. Additionally, 25.5% rated the level of awareness as moderate, while 20.9% rated it as low. Furthermore, 19.1% of the respondents were unsure about the level of awareness.

Table 6 Main key factors that contribute to improper quarrying activities in Mogadishu

Factors	Frequency	Percent
Lack of regulations and enforcement	23	20.9
Poverty and economic desperation	23	20.9
Limited knowledge about sustainable mining practices	27	24.5
Corruption and illegal activities	17	15.5
Insufficient government oversight	20	18.2
Total	110	100.0

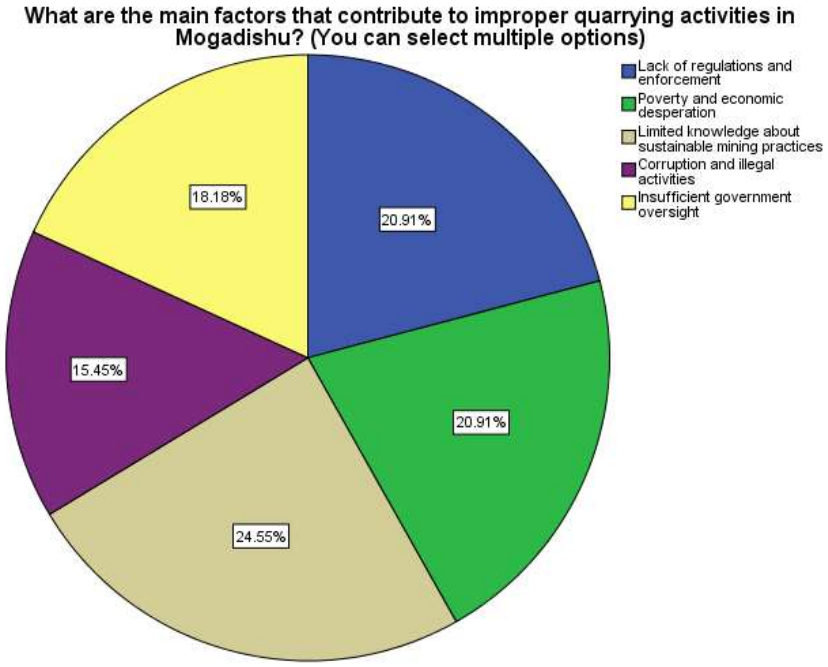

Figure 7 Main key factors that contribute to improper quarrying activities in Mogadishu

Based on the provided data, the respondents were asked to select the main factors contributing to improper quarrying activities in Mogadishu. The options and their corresponding frequencies and percentages are as follows:

- Lack of regulations and enforcement: 23 respondents (20.9%)
- Poverty and economic desperation: 23 respondents (20.9%)
- Limited knowledge about sustainable mining practices: 27 respondents (24.5%)
- Corruption and illegal activities: 17 respondents (15.5%)
- Insufficient government oversight: 20 respondents (18.2%)

The total number of respondents is 110.

These results suggest that the respondents identified multiple factors contributing to improper quarrying activities in Mogadishu. The most commonly selected factors were limited knowledge about sustainable mining practices (24.5%) and lack of regulations and enforcement (20.9%). Additionally, poverty and economic desperation (20.9%), insufficient government oversight (18.2%), and corruption and illegal activities (15.5%) were also cited as significant factors. It's important to note that these results are based on the perceptions of the respondents and may not encompass all possible factors contributing to improper quarrying activities in Mogadishu. Additionally, without additional context or information, it is difficult to determine the relative importance or interplay between these factors.

Table 7 Awareness of any negative environmental impacts caused by quarry mining activities in Mogadishu

Category	Frequency	Percent
Yes	38	34.5
No	72	65.5
Total	110	100.0

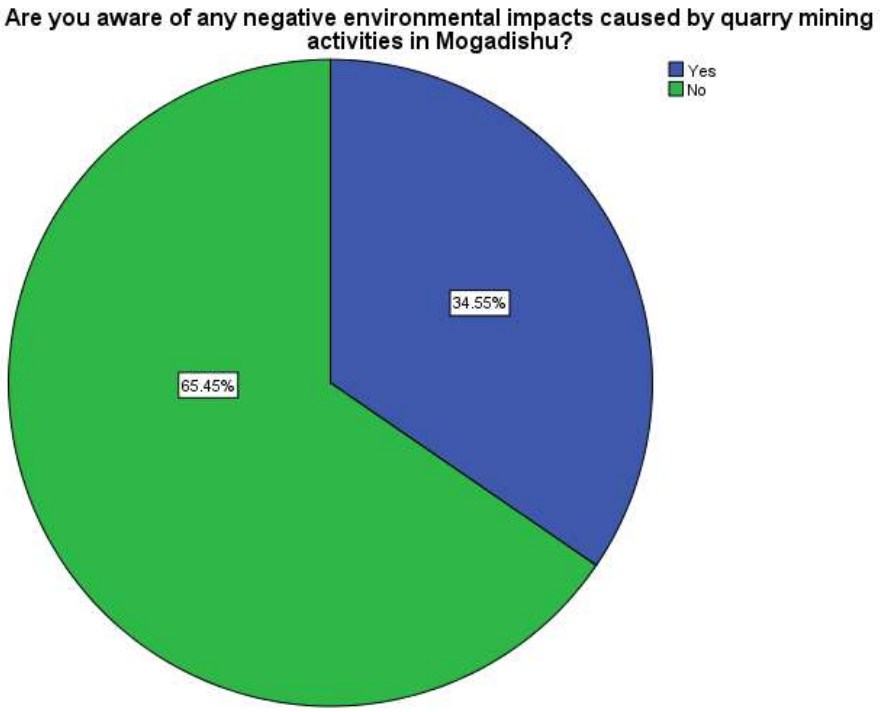

Figure 8 Awareness of any negative environmental impacts caused by quarry mining activities in Mogadishu

Based on the provided data, the respondents were asked if they were aware of any negative environmental impacts caused by quarry mining activities in Mogadishu. The response options and their corresponding frequencies and percentages are as follows:

- Yes: 38 respondents (34.5%)
- No: 72 respondents (65.5%)

The total number of respondents is 110.

These results indicate that among the respondents, 34.5% are aware of negative environmental impacts caused by quarry mining activities in Mogadishu, while the majority of respondents (65.5%) answered that they are not aware of such impacts.

It's important to note that these results reflect the awareness or knowledge of the surveyed individuals and may not capture the complete understanding of the environmental impacts of quarry mining activities in Mogadishu. Additionally, without further information, it is unclear why some respondents may be more aware of these impacts than others.

Table 8 Effect of quarrying activities to the environment and local community

Effects	**Response frequency and percentages**	
	Number of responses (n)	Percent frequency (%)
Dust particles (PM)	96	28.49%
Noise	84	24.93%
Shocks	64	18.99%
Vibration	60	17.80%
Dumping	13	3.86%
Insecurity	5	1.48%
Disrupting classes	3	0.89%
Unsure	12	3.56%
Total	**337**	**100%**

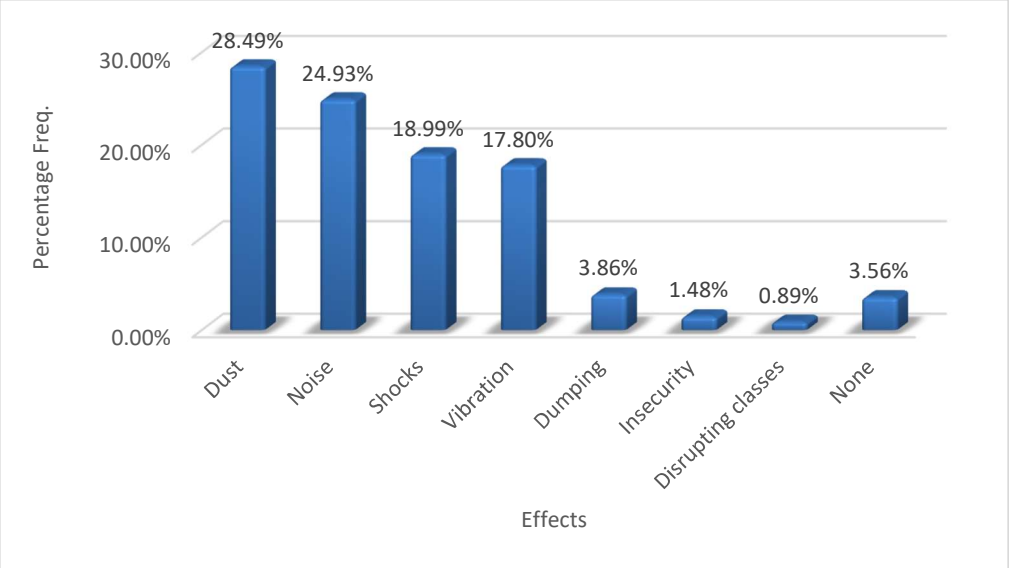

Figure 9 Effect of quarrying activities to the environment and nearby community (Source: Author 2023)

The once-weekly or as-needed blasting produced a lot of noise and vibration, which to some extent had an impact on the nearby homes. According to Table 8, the majority of inhabitants complained about shock, vibration, and dust, with 28% citing the latter as a cause of several health issues, 25% citing noise from blasting and large vehicles used for transportation, and 18% citing shock and vibration. A few respondents reported being startled by the unexpected noise produced by the use of explosives and the ground trembling brought on by rock blasting. According to accounts, inhabitants who live close to the quarry site experience tension, anxiety, insomnia, and exhaustion as a result of the ground vibration that occurs when explosives are detonated during quarrying activities. It's important to note that these perceptions reflect the understanding and opinions of the surveyed individuals and may not capture the complete range of environmental impacts caused by improper quarry mining operations. Additionally, without further context or information, it is difficult to determine the specific reasons behind these perceptions or the extent of the environmental impacts.

Table 9 Health-related issues experienced by the respondents as a result of quarry mining operations

Lung illness	22.90%
Hearing trouble	20.80%
Chest problem	19.80%
Common cold	18.80%
Coughing	10.40%
Eye infection	7.30%

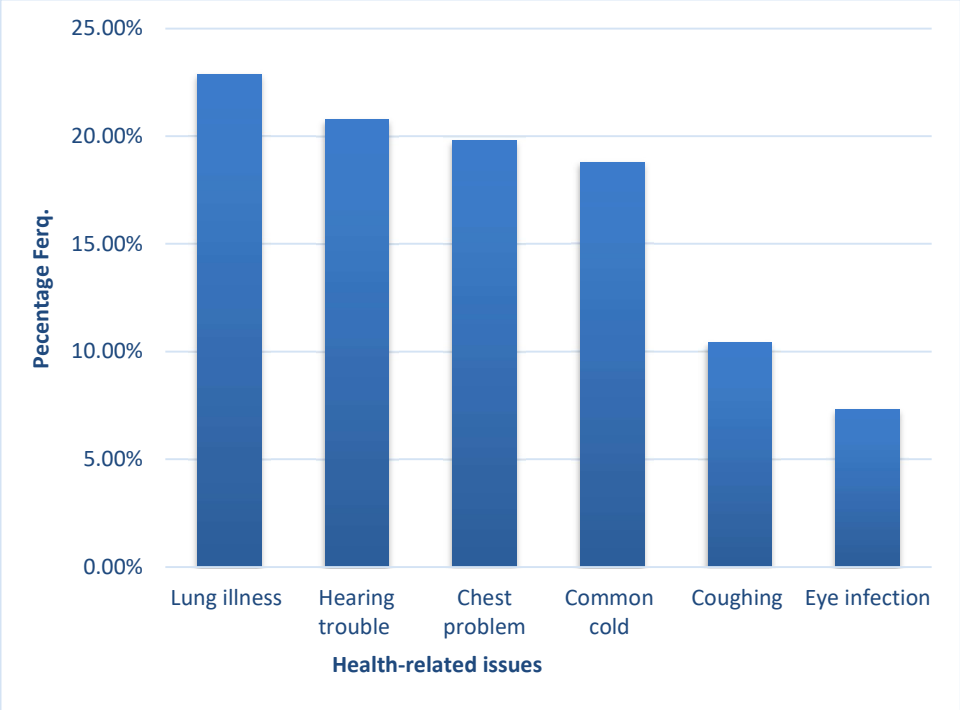

Figure 10 health-related issues experienced by the respondents as a result of quarry mining operations

Based on the provided percentages, here is a breakdown of the reported health issues among the quarry workers:

Lung illness: 22.90% of the respondents reported having lung illnesses.

Hearing trouble: 20.80% of the respondents reported experiencing hearing problems.

Chest problem: 19.80% of the respondents reported having chest problems.

Common cold: 18.80% of the respondents reported having common cold symptoms.

Coughing: 10.40% of the respondents reported experiencing coughing.

Eye infection: 7.30% of the respondents reported having eye infections.

These percentages indicate the prevalence of these specific health issues among the surveyed quarry workers. It's important to note that these percentages are based on the reported data and may not reflect the entire population of quarry workers or the complete range of health issues they may face.

Table 10 Taking appropriate measures to address the social and health impacts of quarry mining activities in Mogadishu by government and local authorities

Category	Frequency	Percent
Yes	38	34.5
No	72	65.5
Total	110	100.0

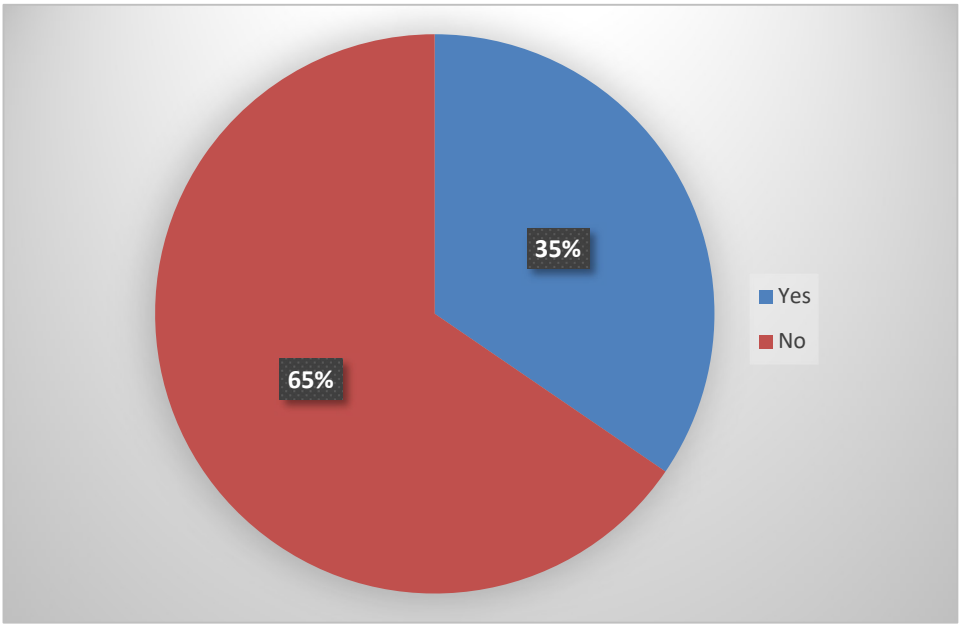

Figure 11 Taking appropriate measures to address the social and health impacts of quarry mining activities in Mogadishu by government and local authorities

It's important to note that these perceptions reflect the understanding and opinions of the surveyed individuals and may not capture the complete range of environmental impacts caused by improper quarry mining operations. Additionally, without further context or information, it is difficult to determine the specific reasons behind these perceptions or the extent of the environmental impacts.

There was a total of 110 cases included in the analysis. All 110 cases were considered valid and included in the analysis. No cases were excluded based on the variables used in the procedure. This means that the data from all 110 respondents was used to calculate the frequencies and percentages for the variables examined in the analysis. There were no missing or excluded cases, and the entire dataset was utilized for the analysis.

Summary of Findings

Based on the provided data, several key findings can be derived from the information presented:

1. Gender Distribution: Among the 110 respondents, there was an almost equal representation of males (49.1%) and females (50.9%).

2. Age Distribution: The majority of respondents fell within the 26-35 age range (48.2%), followed by the 18-25 age range (14.5%). The remaining respondents were distributed across the 36-45 years (10.0%), 46-55 years (15.5%), and above 55 years (11.8%) age groups.

3. Occupation: The largest occupational group among the respondents was quarry owners/operators (47.3%), followed by quarry workers (24.5%) and local residents/community members (22.7%). Environmental activists constituted the smallest group (5.5%).

4. Level of Awareness: When asked about the level of awareness among quarry workers and operators about proper mining practices, the responses varied. The majority of respondents rated the level of awareness as high (34.5%) or moderate (25.5%), while a significant portion considered it low (20.9%) or were unsure (19.1%).

5. Factors Contributing to Improper Quarrying Activities: The main factors identified by respondents as contributing to improper quarrying activities in Mogadishu were lack of regulations and enforcement (20.9%), poverty and economic desperation (20.9%), limited knowledge about sustainable mining practices (24.5%), corruption and illegal activities (15.5%), and insufficient government oversight (18.2%).

6. Awareness of Negative Environmental Impacts: A notable proportion of respondents (34.5%) were aware of negative environmental impacts caused by quarry mining activities in Mogadishu, while the majority (65.5%) were not aware.

7. Social and Health Impacts: The majority of respondents (90.9%) reported witnessing or experiencing social or health-related issues as a result of quarry mining operations.

8. Government Response: A significant proportion of respondents (83.6%) believed that the government and local authorities were taking appropriate measures to address the social and health impacts of quarry mining activities, while a smaller percentage (14.5%) disagreed with this perception.

These findings provide insights into the demographics, perspectives, and perceptions related to quarry mining activities in Mogadishu, including gender representation, age distribution, occupational backgrounds, level of awareness, factors contributing to improper quarrying, environmental and social impacts, and the perceived effectiveness of government measures.

Furthermore, quarrying and mining technology have had adverse impacts on sub-surface aqueous water-tables. Although this may appear as a little aspect, the implications are very alarming. This includes the destruction of important soil biological diversity thus hampering soil microbial processes, water infiltration capacity, increased silt loads, and changes in groundwater table as a result of deep mines (Figure 4.10). In turn, these incidences adversely affect above-ground plant composition and structure, exposing the land to high evapotranspiration, loss of soil micro-organisms, destruction of plant cover and overall degradation in the exposed mining areas (Ellis, 2005; Sarupia et al., 2019). Surrounding communities will also sooner or later have poor access to water due to reduced water tables, and increased pollution. If unregulated, most of these challenges result in poor food production in the affected areas, water-borne diseases and increased poverty in the mining and quarry sites. (Brown n.d.2006)

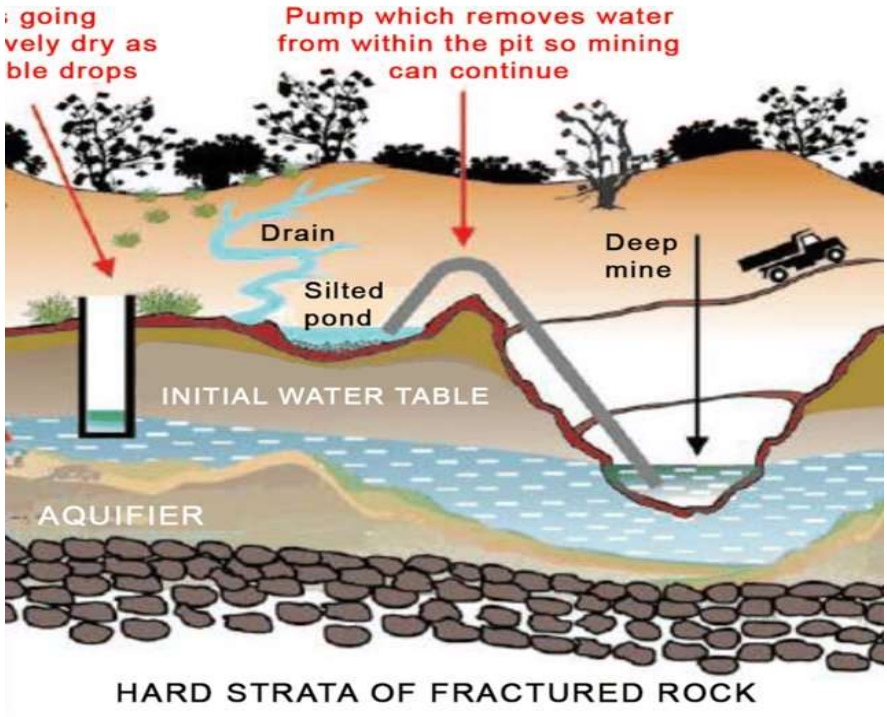

Figure 12 Quarrying impacts to below ground water table (Source: Sarupia et al., 2019)

4.1.4 Protective Gear in Quarries

Under the Occupational Safety and Health Act, it is mandatory for employers to provide and sustain appropriate and effective protective gear and equipment for their employees. This includes, but is not limited to, gloves, footwear, goggles, and head coverings as required, particularly for those employees engaged in tasks such as breaking or dressing stone, concrete, or slag in their workplace. Although many quarry workers are given access to the protective equipment they need, some do not, making them vulnerable to the dangerous working circumstances. Only 28.1% of those studied had access to personal protective equipment (PPE), while 71.9% did not, it was found during study. Even the people who did have protective equipment did not have it completely or in excellent shape.

The majority of the inhabitants in the Mogadishu region were found to be afflicted with common illnesses including malaria and the common cold, which may or may not be directly related to the quarrying activities in the region, according to three health centers that were visited. When the quarries were constructed, the region was largely bare and was used by pastoralists to graze their livestock. The following problems have arisen as a result of residential home development brought on by population increase in specific places over time. The enterprises encounter issues or difficulties as a result of their operations in their region of operation because of their proximity to residential areas.

When the quarry activities first started, the area was uninhabited. However, as the population has grown, more residential buildings have been built in the area, and as a result, the companies have experienced the following: encroachment of human settlement 38.9%, frequent complaints from area residents 27.8%, administration interference 22.2%, and conflict with area residents 11.1%. Many problems exist for quarry workers during work. 38.1% complained of poor working conditions, such as a lack of adequate equipment, 23.8% complained of low pay compared to the hard work they do, 23% had problems with the type of equipment they were given, which was old and incomplete, 7.1% reported that the machine used was old, and in some cases, they had to go without work for several days, 4.0% did not have permanent employment because they were casual workers, and 3.2% experienced illness related to their work. The effects of the quarries are mixed. The quarry benefits the locals in addition to its negative effects. Due to the purchasing power of the quarry workers, 14.8% are active in business, 6.3% have been able to obtain employment from the quarry either directly or indirectly, 7.0% have been able to obtain construction materials, but 71.8% have seen no benefits from the quarry. Numerous recommendations were made by locals to lessen the impact of the quarry.

According to the results, 30.5% of all area residents who were surveyed felt that there was a need to lessen the dust that the quarries produced, 29.5% suggested that the blasting be reduced, 21.4% suggested that the quarries be moved to another location, the roads be repaired or built in cooperation with the quarry companies, and the quarry be fenced to prevent accidents like people falling into the quarry pits. The Occupational Safety and Health Act further stipulates that compensation for harm and mishaps brought on by quarrying in the region is necessary. The region was mostly used for farming and grazing before the quarries were built, but when quarrying got under way, a lot of the vegetation was destroyed. Only a few businesses have succeeded in their attempts to plant trees. Dust, noise, tremors, and vegetation loss are all effects of quarry activity. Companies that operate quarries have made some efforts to lessen these effects. The crushing plant and the loading area produce a lot of dust, which they strive to lessen by watering. Mild explosives and small noise-reducing equipment are used in the quarry to decrease noise pollution.

In the building sector, quarrying is an essential activity. It produces the materials needed for building and constructing roads. The quarrying industry, along with other closely linked sectors like the manufacturing of drainage materials and building blocks, employs a sizable population. The majority of quarry businesses also work in building in addition to quarrying. Quarrying has both beneficial and detrimental consequences, but it seems that the detrimental aspects exceed the beneficial. The quarries interfere with the efficient running of the local human settlement because they are located extremely close to homes and even schools. The health of the residents is impacted since the quarries discharge a lot of garbage close to the residential area Due to quarrying activity as well as neighboring activities like transportation, the quarries produce a lot of dust. Heavy lorries that can carry up to 12 tons and are used for transportation damage the roadways by spewing out a lot of dust. The ancient equipment employed in the quarrying activity produces a lot of dust, which has an impact on both the employees and those nearby. No proof was discovered during the inquiry, despite the business owner's claims that they water to limit the amount of dust emitted.

The protective equipment that quarries workers who engage in quarrying activities need to shield themselves from danger as they go about their everyday business inside the quarry is lacking. Face masks are a need for quarry workers in order to protect them from the dust that is produced during their work. But in our instance, we found that the bulk of them lack the requisite tools. Some quarry sites don't have proper fences surrounding their property, which is particularly dangerous for passing by individuals who could fall into the more than 30-meter-deep quarry pits. The residents who live close to the quarries are put in danger because of this. The quarry companies neglected to place important warning signs.

4.1.5 Potential sustainable solutions

The interviewed respondents were asked various ways in which unsustainable mining

practices could be solved. Various suggestions were provided and summarized as captured in the following table 4.4. in this survey, most respondents indicated that mining and quarry-based challenges will be solved mainly through establishment of penalties to the unsustainable mining companies (93.1%), launching pasture restoration practices in affected areas (85.5%), creating youth funds to support in ecological restoration of degraded areas (80.9%) as a form of employment and re-forestation in degraded lands (72.5%).

Other solutions included informed participatory decision-making in the quarrying and mining process by local communities for sustainable resource management, enhancement of awareness and capacity building on impacts on local communities, compensation for affected communities, re-using the materials, and creation of nature reserves in the affected regions.

Table 11 Solutions for sustainable quarrying and mining by the respondents

Possible solution in quarrying and mining sector	Percentages (%)
Strengthening government regulations and policies	65.7%
Re-using the materials	51.2%
Creation of nature reserves in the affected regions	36.1%
Re-forestation in degraded lands	72.5%
Pasture restoration in affected areas	85.5%
Penalties to the unsustainable mining companies	93.1%
Creating youth funds to support in ecological restoration of degraded areas	80.9%
Enhanced awareness and capacity building on impacts on local communities	53.4%
Compensation for affected communities	61.4%
Participatory decision-making in resource management	66.8%

4.2 DISCUSSION

The study's findings and discussions made from r are summarized in this chapter. Internally, the stone quarrying industry plays a significant role in Somalia's economic development and employment generation, hence it requires both financial and academic support through education. The majority of stone miners lack the necessary quarrying skills, according to the report. The lack of training among those who work in Mogadishu's stone quarries creates a harmful work environment. Resource diversification is another aspect of environmental sustainability. The sole source of income for the vast majority of people in Karan and Wadajir districts of Mogadishu is stone quarrying, which has led to over-exploitation. Additionally, it has increased traffic in the quarry area, which has led to land fragmentation and quick mass waste.

The majority of those who labor in stone mining is poor, which is another factor. When quarrying stones, the wealthy members of society take advantage of the needy and receive low pay. The bulk of them do not take the environment into account when quarrying since they do not

appreciate it. Because they had to keep a careful eye on their income, the majority of them appeared to have more employees who were working as apprentices under them. As a result, they did not have time to come in and assert that they were superior workers. The government's monitoring program is crucial since it aids quarrying in taking environmental sustainability into consideration of the instruction for a definitive mining strategy. Many other institutions offered policy and training to promote environmental protection, but they did not follow through, therefore they were useless. The majority of stone quarry workers, according to this study, don't care much about how their jobs affect the environment. The purpose of the study was to look into how quarrying affected the local community and the environment. The study found that men made up the vast majority of quarry responders.

The government bodies responsible for mining activities insist that the adverse environmental impacts caused by mining operations, no matter how detrimental they may be, should be minimized. Additionally, they emphasize the importance of providing sufficient compensation to the communities affected by quarry companies and whose livelihoods have been disrupted due to mining operations. The respondents were asked a number of questions regarding potential remedies for unsustainable mining practices. Several recommendations were offered and collated as a result of this inquiry. The majority of those who responded to this survey believe that penalizing unsustainable mining companies, implementing pasture restoration practices in affected areas, creating youth funds to support the ecological restoration of degraded areas as a source of employment, and reforestation in degraded lands are the primary ways to address mining and quarry-related issues. Development of plans to stop the deterioration in the afflicted areas through improved communication and understanding of how it affects local people, greater capacity building, compensation for impacted groups, reusing the resources, and informed participatory decision-making.

The study determined that the area's quarrying activities had a negative impact on the ecology by leaving scars on the surface that were difficult to repair, making a chunk of the region unprofitable. Due to the presence of quarries nearby, those who live there are susceptible to water-borne illnesses including malaria. The study's findings indicate that some businesses do not give their workers the protective gear they need to keep them safe while carrying out their tasks. Thus, the workers' health has suffered as a result of their silence about their suffering. The investigation also found that some businesses had taken actions to lessen the environmental impact of their operations, even though locals had not been made aware of any of these actions by the quarrying businesses.

The study discovered that certain quarry workers do not have the essential protective gear, and as a result, some of them experience health problems, despite the fact that the Occupational, Safety, and Health Act (OSHA) mandates that workers be equipped with protective gear. The

following effects on quarry employees exist: Due to the nature of their jobs, 22.9% of them have respiratory infections, 19.8% have chest issues, and 20.8% have hearing issues. Because there is affordable housing nearby, the majority of residents in these neighborhoods are low-income earners who are unable to move. They are therefore forced to endure in silence. The study's conclusions include that the Ministry of Minerals and Natural Resources (MMNR) oversees stone quarrying and that a literature review found a gap between quarrying planning and environmental concerns, but did not provide any solutions. This study found that local involvement in quarrying environmental issues was low. The main reasons that made the need for stone quarrying in the area necessary were poverty and low-income earning. Because the majority of people relied on stone mining as a source of income, the majority of the activities were incompatible with environmental considerations.

The area was mostly used for farming and grazing before the quarries were built, but when quarrying started, a lot of the vegetation was destroyed. Only a few businesses have been successful in their efforts to plant trees. Dust, noise pollution, tremors, and vegetation loss are all effects of quarry activity. Companies that operate quarries have made some effort to lessen these consequences. some of them they strive to reduce the amount of dust at the crushing site and the connecting roads by watering (Somalia Report, 2012). A crucial task in the building sector is quarrying. It produces the supplies needed for developing and constructing roads. Both quarrying and other allied sectors, like block construction and drainage material construction, employ a sizable population. Most quarry businesses also work in the building; therefore, they are not just engaged in quarrying. Both positive and bad consequences of quarrying are present, however, it looks like the negative effects outweigh the positive. The excavations interfere with the efficient running of the local human settlement because they are situated close to homes and even schools. The residential area's health is impacted by the quarries' extensive trash disposal. Due to quarrying activity and other surrounding activities like transportation, the excavations produce large particles of dust. Heavy lorries that can transport up to twelve-tons of rocks harm roadways by leaving behind a lot of dust. The older equipment employed in the quarrying activity releases a lot of dust, which has an impact on both the employees and those nearby. No proof was discovered throughout the investigation, despite the business owner's claims that they water to limit the amount of dust emitted.

The protective equipment that quarries workers who engage in quarrying activities need to shield themselves from danger as they go about their everyday business in the quarry is lacking. Face masks are required for quarry workers in order to protect them from the dust that is produced during their work. In our case, however, we found that the bulk of them lack the requisite tools. Some quarry sites don't have sufficient fences surrounding their property, which is extremely dangerous for passing by individuals who could fall into the more than 30-meter-deep quarry pits. Residents who live close to quarries are at risk because of this. As much as we acknowledge the

economic advantages of quarry operations in Somalia, we also need to acknowledge the environmental concerns associated with them in order to come up with solutions. The host community's most significant intervention in response to the environmental risks (water pollution) posed by the companies was the availability of alternate drinking water sources. Mining corporations ought to put more effort into reforestation, resettling impacted populations, and other initiatives targeted at restoring degraded lands to their pre-mining condition.

Vibration levels from blasting are much lower than those that could endanger a building's structural integrity. However, excessive air pressure and ground vibration that travels through the air and ground can annoy local community. There is audible noise when there is over-pressure. Noise can annoy individuals, be a nuisance, interfere with their ability to sleep, and have an effect on wildlife. Residential structures, schools, clinics, nursing facilities, and other buildings are just a few examples of the noise-sensitive sensors. The noise source, geography, land use, ground cover, and weather at the surrounding location all have a significant impact on the consequences of noise. Fractures that are continuous or have the potential to do so can be the source of large water leaks into or out of the quarry.

Expanding quarry operations near to where groundwater discharges are expected to have a major detrimental impact on groundwater. In order to quarry, it is a good idea to leave some space between the mined pit and the project's property border. However, it is advisable to increase the number of dewatering pumps and sedimentation ponds because the impacts of the increased rainfall and seepage may be significantly limited. It is preferable to have adequate acres for handling surplus runoff and pit water in order to reduce runoff and erosion. Numerous tiny creatures as well as local and migratory birds utilize the habitat. The loss of beneficial wildlife is brought on by habitat fragmentation. The planned project's site may be designated as prime forest, a natural area, or a wildlife habitat. Everything will be lost as a result of the surgery. Environment-related repercussions of construction, such as habitat loss, sedimentation, and erosion, are typically to be expected.(Fang et al. 2009).

In open mines where rock debris is extracted through blasting and crushing, the dust effect is very bad. Pulverized rock dust appears to be both toxic and beneficial when inhaled. According to past studies, those who are exposed to silicic rock dust have a higher risk of developing lung cancer (Guo, 2005). Earth movement during blasting activities increases the likelihood of rock falls that cause damage to neighboring properties and pose a risk to human life. Throughout the working day, activity levels fluctuate, and so does the noise level. Residents living close to a quarry will experience fewer of the negative consequences of quarry activities if a buffer zone is established between them and the quarry area. The minimum distance between homes and workings that has been permitted or advised, according to James (1998), varies greatly, reaching up to 400 meters for sand and gravel workings and 300 to 900 meters for hard rock workings. The effectiveness of distance as a control depends on the terrain and environmental sensitivity of the region. If the

permitted distances are too close together, neither operators nor residents will benefit significantly, if at all. The operators will see that they "risk it" in difficult situations because of the demands of cost and expediency.

Planning for the transition to alternative employment following the closing of the mine, ensuring the equal distribution of money, and making the appropriate expenditures in community development are all examples of economic and social responsibility. Government mining subsidies could fundamentally change a company's ability to turn a profit. In general, Mining Company's obligations to worker health and safety as well as respect for fundamental human rights, cultures, customs, and values fall under the umbrella of social responsibility. The need for social licenses to mine is understood by the International Finance Corporation, the World Bank, the European Bank for Reconstruction and Development, and other development banks and financial institutions. These groups and professionals like the International Council on Mining and Minerals have created a number of principles and suggestions for the integration of social issues and a human rights-based strategy into the operations of the extractive industries. Based on these principles, they have developed and uphold investment guidelines that promote socially and environmentally responsible mining across their investment holdings.

For mining projects that might have an impact on global environmental issues, international discussions should be held, and the parties concerned should be informed (Extractive Industries Review, 2003). Each environmental impact assessment is unique to a specific set of circumstances, and the authorities examine the submissions in light of those conditions even if there are well-established rules and methods for doing so. After approving an applicant's EIA, the authorities grant a miner an environmental license.

The objective of restoration is to bring back biological diversity and resilience to a location and its life processes that have been significantly disrupted or destroyed, usually by human meddling. The need for restoration is one of the most important environmental issues of our time. It arises from a number of factors, including a growing comprehension of how natural processes affect urbanization, its implications for sustainability and quality of life, as well as community concerns and commitments to righting previous environmental wrongs. In its most basic form, restoration refers to the process of returning native populations to their pre-disturbed status after being disturbed. However, in fact, it is impossible to achieve these goals in environments where human activity has significantly affected the local ecosystem.

CHAPTER 5
CONCLUSION

The stone quarrying industry plays a significant role in Somali's economic development and employment generation; hence it requires both financial and academic support through education. The majority of stone miners lack the necessary quarrying skills, according to the report. The lack of training among those who work in Mogadishu's stone quarries creates a harmful work environment. Resource diversification is another aspect of environmental sustainability. The sole source of income for the vast majority of people in Karan district of Mogadishu is stone quarrying, which has led to overexploitation. Additionally, it has increased traffic in the quarry, which has led to land fragmentation and quick mass waste.

The study found that the area's quarrying activities has damaged the ecology by leaving scars on the surface that are challenging to repair, making a chunk of the region unprofitable. Water-borne illnesses like malaria, which are brought on by the existence of quarries nearby, impact residents of the surrounding area. The study's conclusions indicate that some businesses fail to give their workers the safety gear they need to keep them secure while carrying out their tasks. The workers' health has suffered as a result, and they do so in silence. The survey also found that certain businesses have made actions to lessen the impact of their operations on the environment, even if locals have not recognized any of these actions done by the quarrying businesses (Ramella et al. 2019).

The study's findings indicate that the Ministry of Minerals and Natural Resources (MMNR) has the responsibility of overseeing stone quarrying. Additionally, a review of existing literature revealed a disconnect between quarrying planning and environmental concerns, without offering any remedies. This study also observed that there was limited involvement of the local community in addressing environmental issues related to quarrying. These findings align with the objectives of the study. The primary factors driving the necessity of stone quarrying in the area were poverty and low-income levels, as the majority of people depended on stone mining for their livelihoods. Consequently, most of the activities associated with quarrying were not compatible with environmental considerations. However, due to effective governance and government policies implemented since the establishment of the county government, these quarries are now being managed well.

The OSHA proposed changes for the working conditions of the quarry workers. This is attributable to the quarry workers' ignorance of the necessity of using safety gear. The fast

construction of residential facilities closes to protected areas, including quarry sites and highway roads, is a result of bad planning in Mogadishu City. Modern dust-strapping technology should be made mandatory for quarry businesses to utilize, ensuring that very little dust escapes from the site's numerous operations. People who live in those places have suffered as a result of this. This leads us to the conclusion that quarrying activity has primarily had a negative influence on the environment, including the local population, quarry workers, and the physical environment.

The stone quarrying industry plays a significant role in the country's economic development and employment generation. However, there are several challenges and negative impacts associated with the industry. The lack of quarrying skills among stone miners has created a harmful work environment, and over-exploitation of resources has led to environmental degradation and land fragmentation. One of the main issues identified is the exploitation of poor quarry workers by wealthy individuals, leading to low pay and a disregard for environmental considerations. The majority of quarry workers lack the necessary protective gear, resulting in health problems such as respiratory infections, chest issues, and hearing problems. The study also highlights the negative impact of quarrying on the ecology, including vegetation loss, water pollution, and the disruption of local communities.

The government's monitoring program is crucial for ensuring environmental sustainability and the well-being of quarry workers. There is a need for stricter regulations and penalties for unsustainable mining practices. The study recommends implementing measures such as pasture restoration, reforestation, and youth funds for ecological restoration as a source of employment. It also emphasizes the importance of informed participatory decision-making, capacity building, and compensation for impacted groups.

5.1 RECOMMENDATIONS

Government agencies in charge of mining activities should revise their environmental management policies to ensure that the environmental effects of mining activities are kept to a bare minimum, while adequate compensation is paid to host communities whose livelihoods are harmed by quarry companies' mining operations. Several questions regarding potential solutions to unsustainable mining methods were posed to the interviewees. In this investigation, various recommendations were given and compiled. According to the majority of respondents to this survey, the main methods for resolving mining and quarry-related issues include enacting penalties against unsustainable mining companies, implementing pasture restoration practices in impacted areas, setting up youth funds to support the ecological restoration of degraded areas as a source of employment, and reforestation in degraded lands. The creation of strategies to reverse degradation in the affected areas through increased communication and awareness of the impacts on local

communities, increased capacity building, compensation for impacted communities, reuse of the materials, and informed participatory decision-making by local communities in the quarrying and mining process were additional solutions.

For the use of employees, every employer must supply and maintain sufficient, effective, and suitable protective apparel and equipment, including, where needed, proper gloves, footwear, goggles, and head coverings This is particularly true for staff members who work on projects like breaking or dressing stone, concrete, or slag. Not all quarry workers have access to the protective gear they need to defend themselves from the rigorous working circumstances. Only a small percentage of employees received protective gear, it was found during the survey. Even the people who had protective gear had it insufficiently or in poor shape.

5.2 FUTURE RESEARCH

This research reveals various sections that are recommended for future redesigning and improvement of the mining sector to improve the welfare of the environment as well as winning the twin goal of resource allocation and sustainability in the bulging population, trade, and economic environment among developing countries like Somali. The following are some of the recommendations for future research:

1. Use of modern technology and innovations such as GIS, drones, satellites in effectively identifying and supporting critically degraded areas as a result of quarrying and mining operations.
2. Assessing the benefits and drawbacks of subsurface pits and quarries are especially resulting in deep quarrying and mining.
3. Identification of the ecologic quarry elements such as noise, vibration, pollutions and non-organic particles implications and how to manage this exposure.
4. Employee in quarry-site and workplace safety and health implications before and after mining operations, particularly in the mining industries which employ hazardous chemicals and hard-element mining practices.
5. Challenges and solutions associated with land use in such areas affects the local community
6. The impact of quarry mining effluent release on soil on growth characteristics, micro-organisms and plant cover.

REFERENCES

1. Kitterman, Marcel, and Thomas Fartmann. 2023. "Quarry Ponds Are Hotspots of Amphibian Species Richness." Ecological Engineering 190 (May): 106935. https://doi.org/10.1016/J.ECOLENG.2023.106935
2. University of Michigan. "Give Earth a Chance: Environmental Activism in Michigan", Environmental Crisis' in the Late 1960s, Last accessed on May 27, 2023. Available at https://michiganintheworld.history.lsa.umich.edu/environmentalism/exhibits/show/main_exhibit/origins/-environmental-crisis--in-the-
3. UNEP Website. "Supporting Sound Ecosystem Management, Africa, UNEP - UN Environment Programme. Last accessed on May 27, 2023. Available at https://www.unep.org/regions/africa/regional-initiatives/supporting-sound-ecosystem-management
4. Raghunathan, Pratima L., Ellen A.S. Whitney, Kwame Asamoa, Ymkje Stienstra, Thomas H. Taylor, George K. Amofah, David Ofori-Adjei, et al. 2005. "Risk Factors for Buruli Ulcer Disease (Mycobacterium Ulcerans Infection): Results from a Case-Control Study in Ghana." Clinical Infectious Diseases, 40 (10): 1445–53. https://doi.org/10.1086/429623
5. Dejene, W. Z., & RU, R. (2016). Environmental and Social Impacts of Stone Quarrying: In Dire Dawa Administration (Doctoral dissertation, Harmaya University).
6. ReliefWeb. "Somalis Risk Lives and Limbs for the Reconstruction of Mogadishu – Somalia." Published on 24.05.2012. Last accessed on May 27, 2023. Available at https://reliefweb.int/report/somalia/somalis-risk-lives-and-limbs-reconstruction-mogadishu
7. Ozcan, O., Musaoglu, N., & Seker, D. Z. (2012). Environmental impact analysis of quarrying activities established on and near a river bed by using remotely sensed data. Fresenius Environmental Bulletin, 21(11), pp. 3147-3153.
8. Langer, William H. "Potential Environmental Impacts of Quarrying Stone in Karst-A Literature Review." 2001. Last accessed on May 27, 2023. Available at https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=abfd65540c95d37c405aa8dd2b02ba0267abe21f
9. Mononen, T., Kivinen, S., Kotilainen, J. M., & Leino, J. (2022). Social and Environmental Impacts of Mining Activities in the EU. European Parliament.
10. Govt. of New Hampshire. Occupational Traditions – Granite Quarrying: Much of New Hampshire's bedrock is granite, New Hampshire Folklife. Last accessed on May 27, 2023. Available at https://www.nh.gov/folklife/learning-center/traditions/granite-quarrying.htm
11. Peppe, D. J., & Deino, A. L. (2013). Dating Rocks or Fossilised Using Geologic Methods. Nature Education Knowledge, 4(10), 1.
12. Njoku, J.O., Opara, K.D., Okeke, H.M. and Ejiogu, C.C, Production and Uses of Crushed Rock

Aggregate from Intrusive Igneous Rocks: A Review, International Journal of Innovative Environmental Studies Research, 8(1):1-8, Jan.-Mar., 2020

13. Malpass D., "World Bank Group Activities to Address Climate and Environmental Challenges." 2019. Last accessed on May 27, 2023. Avalable at https://blogs.worldbank.org/voices/world-bank-group-activities-address-climate-and-environmental-challenges
14. Darwish, T., C. Khater, I. Jomaa, R. Stehouwer, A. Shaban, and M. Hamzé. 2011. "Environmental Impact of Quarries on Natural Resources in Lebanon." Land Degradation and Development 22 (3): 345–58. https://doi.org/10.1002/LDR.1011
15. Manisalidis, Ioannis, et al. "Environmental and Health Impacts of Air Pollution: A Review Article." Frontiers in Public Health, 8, February 2020, p. 14. https://doi.org/10.3389/FPUBH.2020.00014.
16. Dauda Ahmed, S., Kwaku Agodzo, S., & Amaning Adjei, K. (2021). Designing River Diversion Constructed Wetland for Water Quality Improvement. IntechOpen. doi: 10.5772/intechopen.92119
17. Hobbs, S. L., J. Gunn. 2007. "The hydrogeological effect of quarrying karstified limestone: options for prediction and mitigation." Quarterly Journal of Engineering Geology, 31 (2): 147–57. https://doi.org/10.1144/GSL.QJEG.1998.031.P2.10
18. Assefa, Gashaw, and Aklilu Gebregziabher. 2020. "Environmental Impact and Sustainability of Aggregate Production in Ethiopia." Sandy Materials in Civil Engineering - Usage and Management. https://doi.org/10.5772/INTECHOPEN.90845

APPENDICES

A: Pictures

Figure 13 Mineral mining and environmental integrity (PC: Ahmed Essa)

Figure 14 Damp-sites left after Mining and quarrying operations at Mogadishu (PC: Ahmed Essa)

Figure 15 Dumped scrap from antiaircraft machine gun near Quarry sites (PC: Ahmed Essa)

Figure 16 Active Quarry in Mogadishu (PC: Ahmed Essa)

Figure 17 Quarry site in Mogadishu (PC: Ahmed Essa)

Figure 18 Road construction project in Wadajir District of Mogadishu

Figure 19 Road construction project in Wadajir district of magadishu

Figure 20 Karan Quarry mine in Mogadishu

Figure 21 Quarrying activities at Karan district in Mogadishu (Source: RadioErgo.org)

B: Questionnaire

Questionnaire to be filled by local residents to assess the impacts of proposed quarry mine operations

Dear El-addo and Kawo-godey resident

The purpose of this letter is to request your participation in a study being conducted by student from Delhi Technological University, Delhi India for academic (research) purpose. This study is part of an effort to learn more about how people feel about the risks and benefits of quarry mining the results of this survey will help researcher to better understand the concerns that people have about the environmental, social and health risks related to quarry mining at El-addo and Kawo-godey areas.

We are contacting a random sample of residents in your area to ask them to share their experiencing and opinions about living near the proposed quarry mine. Your responses will be kept completely confidential and will only be released as summaries in which no individual's answers can be identified. You will not be asked to provide your name and you will never be connected to your answer in any way, your participation in this survey is voluntary. However, you can help us very much by taking a few minutes to share your thoughts about the impacts and benefits of quarry mining.

We have enclosed an ink pen for your convenience and a token of appreciation for your help. If you have any questions or comments about this study, we would be very happy to talk with you. we will be returning to collect your completed questionnaire as soon as possible. For additional questions or concerns, you may reach us, or write to us at the address listed at the bottom of this letter.

Thank you very much for helping with this important study.

Yours sincerely.

Jamal Faisal
Maigag99@gmail.com

Sample of Questionnaire

Please answer the following questions by placing a checkmark next to only one answer.

Questionnaire: Assessing the Environmental and Social Impacts of Inappropriate Quarry Mining Projects in Mogadishu, Somalia

Section 1: General Information

Gender:

Male ☐

Female ☐

Age:

18-25 years ☐

26-35 years ☐

36-45 years ☐

46-55 years ☐

Above 55 years ☐

Occupation:

Quarry worker ☐

Quarry owner/operator ☐

Local resident/community member ☐

Environmental activist ☐

Section 2: Factors Influencing Improper Quarrying Activities

How would you rate the level of awareness among quarry workers and operators about proper mining practices?

High ☐

Moderate ☐

Low ☐

Not sure ☐

What are the main factors that contribute to improper quarrying activities in Mogadishu? (You can select multiple options)

Lack of regulations and enforcement ☐

Poverty and economic desperation ☐

Limited knowledge about sustainable mining practices ☐

Corruption and illegal activities ☐

Insufficient government oversight ☐

Section 3: Effects of Quarry Mining Operations on the Environment and local community

Dust particles (PM) ☐
Noise ☐
Shocks ☐
Vibration ☐
Dumping ☐
Insecurity ☐
Disrupting classes ☐
Unsure ☐

Are you aware of any negative environmental impacts caused by quarry mining activities in Mogadishu?

Yes ☐

No ☐

How do you think quarry mining operations affect the following environmental aspects? (Rate each on a scale of 1-5, where 1 = No impact, and 5 = Severe impact)

Water quality ☐

Air quality ☐

Soil erosion ☐

Deforestation ☐

Wildlife habitat destruction ☐

Health-related issues experienced by the respondents as a result of quarry mining operations

Lung illness ☐

Hearing trouble ☐

Chest problem ☐

Common cold ☐

Coughing ☐

Eye infection ☐

Section 4: Anthropogenic Outcomes of Improper Quarrying Activities

Have you witnessed or experienced any social or health-related issues as a result of quarry mining operations?

Yes ☐

No ☐

Do you think the government and local authorities are taking appropriate measures to address the social and health impacts of quarry mining activities in Mogadishu?

Yes ☐

No ☐

Not sure ☐

C: Key Informants

1. Do you know any quarry mining operation in any area?
2. Who are mainly involved in the stone quarrying industry and where do they come from?
3. Why do people join stone quarrying in spite of other economic activities?
4. How do the local communities participate in the quarry site selection?
5. How does stone quarrying enhance the lively hood of local community and the quarry workers?
6. Does the proposed quarry project work out to be socially beneficial and environment

friendly?

7. Are there any benefits and what are they?
8. Does locating quarry close to the habitation of village may lead to detrimental impacts on the local population?
9. What are the effects of stone quarrying on the local population?
10. Who are the stake holders of the quarry mining operations?
11. Whom it may affect the most?
12. What problems are faced the local community and the quarry workers respectively?
13. What is the possible impact of the drilling and blasting operations on the surrounding neighborhood?
14. What tools and techniques are available to control impact of blasting operation to its neighborhood?
15. What are the gaps in our understanding and practices?
16. Are there any mitigation measures put in place to reduce these problems?
17. Are there any government/NGO initiatives to improve the industry in terms of?
    a. Awareness
    b. Funds
    c. Any other (please specify)
18. Is there any governmental authority made a periodic supervision to the company activity impacts on both environment and social livelihood?
19. Does the residents of neighboring communities are aware of risks associated with living near quarry sites, how their general low socio-economic status made them incapable of taking any decisive measure towards relocating elsewhere
20. Do the mining companies maintain a good relation with local community around the mining areas?
21. What kind of project does the quarry owners assisted to the community?
22. Does the enterprise under the study adopt any health care initiative to its employees as well as local community?
23. Who are responsible to rehabilitate quarry sites after closing?
24. What policy and organizational structural measures are available to control quarrying activities in order to reduce environmental impacts?
25. Please list three environmental or health issues that concern you the **most** in decreasing order
26. What type of participations is expected for the future land use change of the quarry area from? Local resident, adjacent offices, quarrying owners, Government, Environmental protection Authority, Teaching and research institutes.